DOCUMENT RESUME

ED 127 327 SP 010 364

AUTHOR Thompson, Patricia; And Others
TITLE A Comparison of the Effects of Two Physical Education Programs on the Physiological Development of Adolescent Boys and Girls.
INSTITUTION North York Board of Education, Willowdale (Ontario).
SPONS AGENCY Ontario Dept. of Education, Toronto.
PUB DATE Aug 75
NOTE 62p.; For related document, see SP 010 363

EDRS PRICE MF-$0.83 HC-$3.50 Plus Postage.
DESCRIPTORS *Cardiovascular System; *Exercise (Physiology); Heart Rate; *Junior High School Students; Muscular Strength; Norm Referenced Tests; Physical Activities; Physical Development; *Physical Fitness; Physiology; Training
IDENTIFIERS *Aerobics; *Ontario

ABSTRACT

The primary purpose of this study was to determine if a specific daily indoor exercise program of a short duration improved the aerobic fitness level of junior high school students between the ages of 12 and 14. A secondary purpose was to compare the performance of participating students with Canadian norms for working capacity and fitness. Also preliminary estimates were made of normal values of cardiovascular respiratory fitness for adolescent boys and girls. It was hypothesized that both boys and girls in the experimental program would show (1) greater gains on the measures of aerobic fitness, i.e., physical work capacity and maximal oxygen uptake, than those in the control program; (2) that there would be no difference between students in the experimental and control programs in terms of nonaerobic measures of strength, speed, and percent of body fat; and (3) that there would be no difference between pretest scores and norms established by the Canadian Association for Health, Physical Education, and Recreation. The study concluded that (1) the aerobic fitness of boys in the experimental school improved, those in the control school did not; (2) this pattern was also evident for girls but not as clearly; (3) both boys and girls in the experimental school significantly improved from pretest to posttest, while control students declined; (4) on the 600-yard run gains were not significant; and (5) six minutes of continuous exercise, or three minutes of exercise followed by three minutes of rest followed by three more minutes of exercise, resulted in increased aerobic power. Contrary to the hypothesis were significant differences between students in the control and experimental programs in terms of nonaerobic measures. These differences varied with age and did not show any consistent trends. (DMT)

Documents acquired by ERIC include many informal unpublished materials not available from other sources. ERIC makes every effort to obtain the best copy available. Nevertheless, items of marginal reproducibility are often encountered and this affects the quality of the microfiche and hardcopy reproductions ERIC makes available via the ERIC Document Reproduction Service (EDRS). EDRS is not responsible for the quality of the original document. Reproductions supplied by EDRS are the best that can be made from the original.

NORTH YORK BOARD OF EDUCATION

RESEARCH REPORT

ED127327

A COMPARISON OF THE EFFECTS OF TWO PHYSICAL EDUCATION PROGRAMS ON THE PHYSIOLOGICAL DEVELOPMENT OF ADOLESCENT BOYS AND GIRLS

Patricia Thompson, Patricia Crawford, A.E. Virgin and R.C. Goode

August, 1975

2

SP 010 364

U S DEPARTMENT OF HEALTH
EDUCATION & WELFARE
NATIONAL INSTITUTE OF
EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

TABLE OF CONTENTS

		Page Number
ACKNOWLEDGEMENTS		i
INTRODUCTION		1
Purpose		1
Background of Study		1
HYPOTHESES		3
METHOD		3
Sample		3
Physical Measures		4
Procedure		6
RESULTS		8
PART A:	Description of Indoor Aerobic Program	8
	Researcher's Subjective Observations	10
PART B:	Height, Weight, Percent Body Fat	13
	Aerobic Measures	17
	Additional Measures (Grip Strength, Peak Flow)	26
	CAHPER Tests	26
CONCLUSIONS		48
REFERENCES		49
APPENDICES		50

ACKNOWLEDGEMENTS

This study was a co-operative venture among two Junior High Schools in the Borough of North York and the Department of Physiology, Faculty of Medicine, Department of Physical and Health Education, Faculty of Education at the University of Toronto.

The major portion of the funding for this study was provided by the Ministry of Education for the Province of Ontario as a Grant-in-Aid of Educational Research.

INTRODUCTION

Purpose

The primary purpose of the study was to determine if a specific daily indoor exercise program of a short duration (6 minutes) improved the aerobic fitness level of junior high school students between the ages of 12 through 14.

A secondary purpose was to compare the performance of participating students with Canadian norms for working capacity and fitness. As well, preliminary estimates would be made of normal values of cardiovascular respiratory fitness for adolescent boys and girls.

Background of the Study

"Aerobics" has become a familiar term to many people because of the research of Dr. Kenneth Cooper (1968) with the United States Air Force. He has developed a system by which adult men and women can first determine their physical fitness in terms of cardiorespiratory endurance, and then institute a conditioning program to improve their fitness.

Aerobic means literally, with oxygen. Aerobic exercises "demand oxygen without producing an intolerable oxygen debt, so that they can be continued for long periods. Your lungs begin processing more air and with less effort, your heart grows stronger, pumping more blood with fewer strokes, the blood supply to your muscles improves, and your total blood volume increases..... You are increasing your oxygen consumption and consequently your endurance capacity". (Cooper, page 22).

As Cooper's research program has included only adults, he has no first hand information regarding the fitness of American adolescents. However, he feels that when nearly two-thirds of the young Air Force recruits who are barely out of their teens fail to qualify for the "good" fitness category as defined by Cooper, it is unlikely that a majority of American youth are physically fit.

Canadians have also shown increasing interest in and concern with the physical fitness of the population, as Canadian youth are "now being brought up in an era of better nutrition and more leisure time, but subject to new problems being created by an increasingly automated society."*

---

* "The CAHPER Fitness Performance Test Manual for Boys and Girls 7 to 17 years of age." Canadian Association for Health, Physical Education and Recreation, 1966.

One outcome of this concern was the development of national norms of physical performance for Canadian children and youth by the Canadian Association for Health, Physical Education and Recreation. Each of the six tests developed measures a different aspect of fitness, e.g. muscular strength, agility, speed and endurance. The endurance test, i.e. the 300 yard run, however, does not provide sufficient information regarding cardiovascular-respiratory fitness.

The Canadian Association for Health, Physical Education and Recreation has also developed national norms of physical work capacity for boys and girls, age 7 - 17, based on a sample of 2107 children from across Canada. However, in order to use the norms, considerable equipment, e.g. a bicycle ergometer, is needed to gather the heart rate data. Such equipment is not often readily available to public school physical education staff.

A review of the literature indicated that relatively few studies have been conducted to provide normal values on measures of working capacity (i.e. maximal oxygen uptake) for adolescents, although there are several studies which have involved pre-adolescents, i.e. children from 9 - 13.

Astrand (1952) and Ekblom (1969) collected maximal oxygen uptake data on Swedish school children and although their results have often been used by other researchers as a standard of comparison, both of these studies involved only boys, and were based on very small samples. Astrand's study included 13 boys, 10 - 11 years, and 19 boys, 12 - 13 years, while Ekblom's study was based on 6 boys who were 11 years at the beginning of the study.

In 1964, members of the School of Physical Education, University of Saskatchewan, initiated a 15 year longitudinal study of growth and development with 214 Grade 1 boys. A group of girls was added to the study in 1965. Each year, measures of physiological response to exercise, strength, reaction-movement time, body type fitness performance, flexibility and anthropometry are collected. This study will ultimately provide comprehensive information for young children, pre-adolescents, adolescents and young adults regarding the effects of strenuous exercise and the effects of growth, sex and aging on fitness.

Goode, Levison, Hughes, Johnson and Langer (1969) determined maximal oxygen consumption values for 28 boys, age 11 - 13, attending a private school. Their results indicated that the sample had higher maximal oxygen uptake values when compared to other Canadian children of similar age and weight. However, they do point out that the sample was biased in terms of the academic achievement and socio-economic status of the boys.

Recent work on the amount and intensity of activity occurring in physical education classes and controlled ice hockey practices led one of the authors to believe that the activity level of most physical education classes was minimal.

Another Canadian study by Shephard et al (1969) was conducted as part of the International Biological Programme which had as one of its objectives the completion of detailed

studies of working capacity on populations of primitive peoples, athletes, city-dwellers and school children. The sample was comprised of 70 pupils, age 10 - 12, drawn from Grades 4, 5 and 6 in ten Metropolitan Toronto schools. Measures of working capacity and related parameters were gathered from each child during two testing sessions. Shephard et al reported that the results obtained in terms of cardio-respiratory endurance were similar to those reported from other surveys in Canada, the United States, Czechoslovakia and Italy. However, the boys were a little poorer and the girls much poorer than the Swedish children tested by Astrand. Further, although few of the children were obviously fat, the Canadian sample tended to have a slightly higher mean weight than comparable samples from other countries. Shephard et al concluded therefore, that "when coupled with poor aerobic power, it would appear that over-nutrition of the North American population now commences in childhood". (p.709). Further, "It would appear that among Canadian children, lack of activity and a poor level of cardiorespiratory fitness is a more serious problem in girls than in boys". (p.710).

It is evident that there is a paucity of data for adolescents and particularly girls.

HYPOTHESES

It is hypothesized that both boys and girls in the experimental program will show greater gains on the measures of aerobic fitness, i.e. physical work capacity and maximal oxygen uptake, than boys and girls in the control program.

Further, it is hypothesized that there will be no difference between students in the experimental and control programs in terms of the non-aerobic measures of strength, speed and percent body fat.

Finally, there will be no difference between the pre-test scores and the CAHPER norms as described in the background section.

METHOD

Sample

In the fall, the sample included approximately 500 students in each of two North York Junior High Schools which were similar in terms of the amount of time allotted to physical education and the socio-economic status of the communities they served. The 1000 participating students were randomly selected at the Grade 7 through 9 levels providing for an equal representation from both sexes. The nurses' lists were checked to identify and exempt those students who had any type of physical disability (3%) which

might interfere with their ability to complete the tests. The data collected were used not only to determine each student's fitness level but also to compare their performance with Canadian norms and to make preliminary estimates of normal values of cardiovascular fitness for adolescent boys and girls.

In the spring, the sample was randomly selected from among those students who had participated in the fall. The primary concern at that time was to note any differences that existed between the control and experimental school students with respect to the aerobic measures taken in the fall. Therefore, a smaller but more than sufficient sample of 600 students was used.

Physical Measures

The following measures were obtained for each student and recorded on his individual score sheet (see Appendix A).

Anthropometry

Measurements of each child's height (in centimetres) and weight (in kilograms) were recorded.

The percentage of body fat for each student was measured by skin fold calipers at several different areas of the body. For the boys the areas were the triceps area on the back of the arm, the subscapular region on the back, the chest, the superiliac region (hip), the abdomen, and the front thigh. For the girls, the areas were the triceps area on the back of the arm, the subscapular region on the back, the superiliac region (hip), the abdomen and the front and back thigh. All of the measurements were recorded on the student's score sheet.

Muscular Strength

A hand-grip Stolting Dynamometer was used to obtain a measure of muscle strength. The student was asked to hold the dynamometer in his hand, keep his arm straight by his side without touching his body, and squeeze the apparatus as hard as he could. The student was allowed to familiarize himself with the apparatus, and was then given two trials on the dynamometer. Measurements were taken for both hands, the higher of the two readings was recorded and the dominant hand score circled on the student's score sheet.

Fitness Tests

Students were administered each of the following six tests by the Physical Education staff at each school. Each test measures a different aspect of fitness and gives a good indication of the physical status of each student. These tests were developed by the Canadian Association of Health, Physical Education and Recreation (CAHPER).

1. The One Minute Speed Sit Up tests the muscular strength and endurance of the abdominal muscles.
2. The Standing Broad Jump measures the explosive strength or power of the legs.
3. The Shuttle Run determines one's speed and agility.
4. The Flexed Arm Hang indicates the muscular strength and endurance of the arm and shoulder muscles. This test requires that the individual pull himself up and hold himself at eye level on a chinning bar. One school did this test both at eye level and chin level to note any significant differences.

5. The 50 yard run measures speed.
6. The 300 yard run indicates stamina or endurance.

600 Yard Run

Students were asked to run the 600 yard run as a further indication of stamina or cardiovascular endurance. It was also used to determine the validity and reliability of the 600 yard run as a measure of an individual's endurance.

Physiological Measures

Peak expiratory flow (P.E.F.) is the measure of the maximum flow rate of air (liters/minute) in a single forced expiration as measured by the Wright spirometer. Each student was asked to blow into this instrument as hard and as fast as he could. The highest value from three attempts was recorded.

Each individual's heart rate was determined while pedalling a bicycle ergometer. Each student was connected to an electro cardiogram by three electrodes. Before he began to work his resting heart rate was recorded on the machine. Then he continuously pedalled the ergometer at three sub-maximal work loads for a total time of sixteen minutes. A metronome was placed in the room so that all could hear the constant steady beat that it emitted and therefore could pedal to that rhythm for the entire test. Each student worked against the first work load for four minutes, and against the second and third work loads for six minutes each. Heart rates were recorded at the fourth, eighth, ninth, fourteenth and fifteenth minutes.

From the bicycle ergometer test, several other calculations were recorded. Physical work capacity measures the amount of work or resistance an individual must pedal against to bring his heart rate up to 170 beats per minute. This value must be divided by the individual's weight as this measurement varies with body size. By plotting heart rate versus work load and then extrapolating the line to a heart rate of 170, the physical work capacity (PWC_{170}) of the student was determined (see Appendix B).

The Astrand calculation is another means to indirectly predict an individual's maximal oxygen uptake. The maximal oxygen uptake for the individual was predicted by using the Astrand nomogram (see Appendix C).

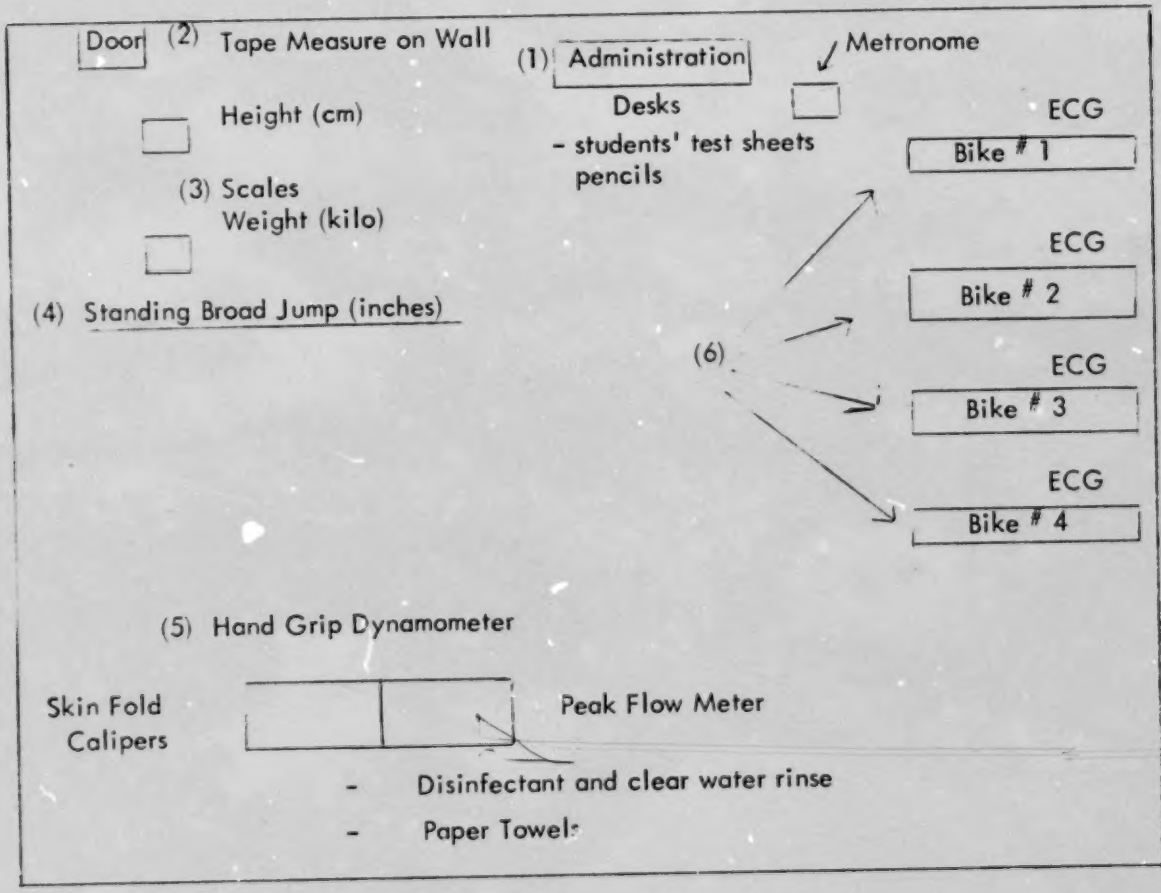
12 Minute Field Test

Students were asked to run the 12 minute field test. This test was developed by Cooper for adult men and provides a relatively simple method for estimating maximal oxygen consumption whereby the distance covered in 12 minutes was translated into milliliters of oxygen consumed. These data provide the basis for Cooper's Physical Fitness Categories.

Procedure

From early September to the end of October pre-test measures were obtained from students in both schools. Testers were recruited from a variety of sources, e.g. university students, Teachers' College students, Grade 13 students from York Mills Collegiate and individuals with some background or interest in physical fitness. Professor T. Pollandi (Director of Athletics for Scarborough College)Professor Woch, Mr. Tiit Romet, Dr. J. Duffin and Dr. R. Goode Associate Professor of the University of Toronto) alternately supervised the testing situations throughout this seven week period. The physical education staff at each school tested the students on all the CAHPER tests, 12 minute field test and the 600 yard run. The remainder of the tests were conducted in one room that was allotted to the fitness testers by each school.

The fitness testing room was set up as diagramed below.



A student involved in the test situation would enter the room and proceed to (1). Here he was given a pencil and a fitness score sheet and was asked to fill out his name, age, birth date and sex. Upon completion of the sheet he was directed to one of the stations (2) - (5). Each student had to go through the 5 stations before proceeding to the bicycle ergometers.

At station (2) one tester recorded the students' height in centimeters and then measured his weight in kilograms at (3). At station (4) the student was given one trial jump and then three other jumps of which the highest reading was recorded by a tester. At station (5) there was one tester measuring skinfold readings and grip strength values, one tester recording these values and another tester measuring the students' peak flow.

The students rotated from one station to the next until they had completed all of the tests and then proceeded to a bicycle ergometer for the 16 minute test. At the completion of the bike test, each student's record sheet was checked by the individual tester to make sure that all the pertinent information had been recorded, and then the sheet was given to the administrator who filed all the results in a binder.

The testing sessions coincided with the particular school's timetable. Four students could complete the entire circuit in 30-35 minutes so therefore 32 - 36 students could be tested per day.

The maximum number of testers needed per day was seven. Four worked the bicycle ergometers and also helped with the long jump and height and weight measures and the other two measured grip strength, body fat and peak flow. A supervisor circulated throughout the session checking equipment and ensuring reliable and accurate measurements.

An indoor aerobic program was carried out in the experimental school for the four month period, from November to February. The other school, the control, conducted their usual physical education program. The researcher visited both schools to observe and describe the aerobic program and the physical education classes while in progress (i.e. the amount of activity, the amount of instruction, kinds of activity, degree of physical demand put on the individual, size of class, facilities, etc.)

From the middle of February to the end of March post-test measures were obtained from the students in both schools. The same procedure was used as described for the pre-test situation.

A feedback booklet was made up for each individual (see Appendix D). This booklet gave a brief description of the test and then gave the student's score and how he performed in relation to other students of the same age in his school. These booklets gave the results for both the pre-and post-test measures.

RESULTS

The results are presented in two parts. Part A includes a description of the indoor program that was carried on at the experimental school and the subjective observations of the researcher. There is also a brief comparison between the physical education programs within the two schools.

Part B includes all the descriptive statistics of this study.

PART A

DESCRIPTION OF THE INDOOR AEROBIC PROGRAM

The experimental school implemented a nine minute circuit at the end of each physical education class. Even when the classes were being instructed in health, the students would be dismissed approximately fifteen minutes early so that everyone could participate in the circuit.

Three circuits were developed by the staff of the school (red, gold and white) to give the students a variety of exercises from day to day. Each circuit had three levels of difficulty (easy, more difficult and most difficult) and only three stations, skipping, running and calisthenics.

The skipping and running activities lasted for three minutes each and in the calisthenics area the student was required to execute three exercises each of a one minute duration. Each class was divided into three groups (A,B, or C) and each student would remain in this designated group for the entire indoor program. It was at the calisthenics area that these subgroups (A,B or C) were needed to reduce the number of students involved in each exercise.

The students were assigned to a different circuit each day. For example, if one student was on the red circuit Monday, he would switch to the gold Tuesday, the white Wednesday and back to the red on Thursday. The different stations and exercises were identified for the students by huge signs posted around the gymnasium.

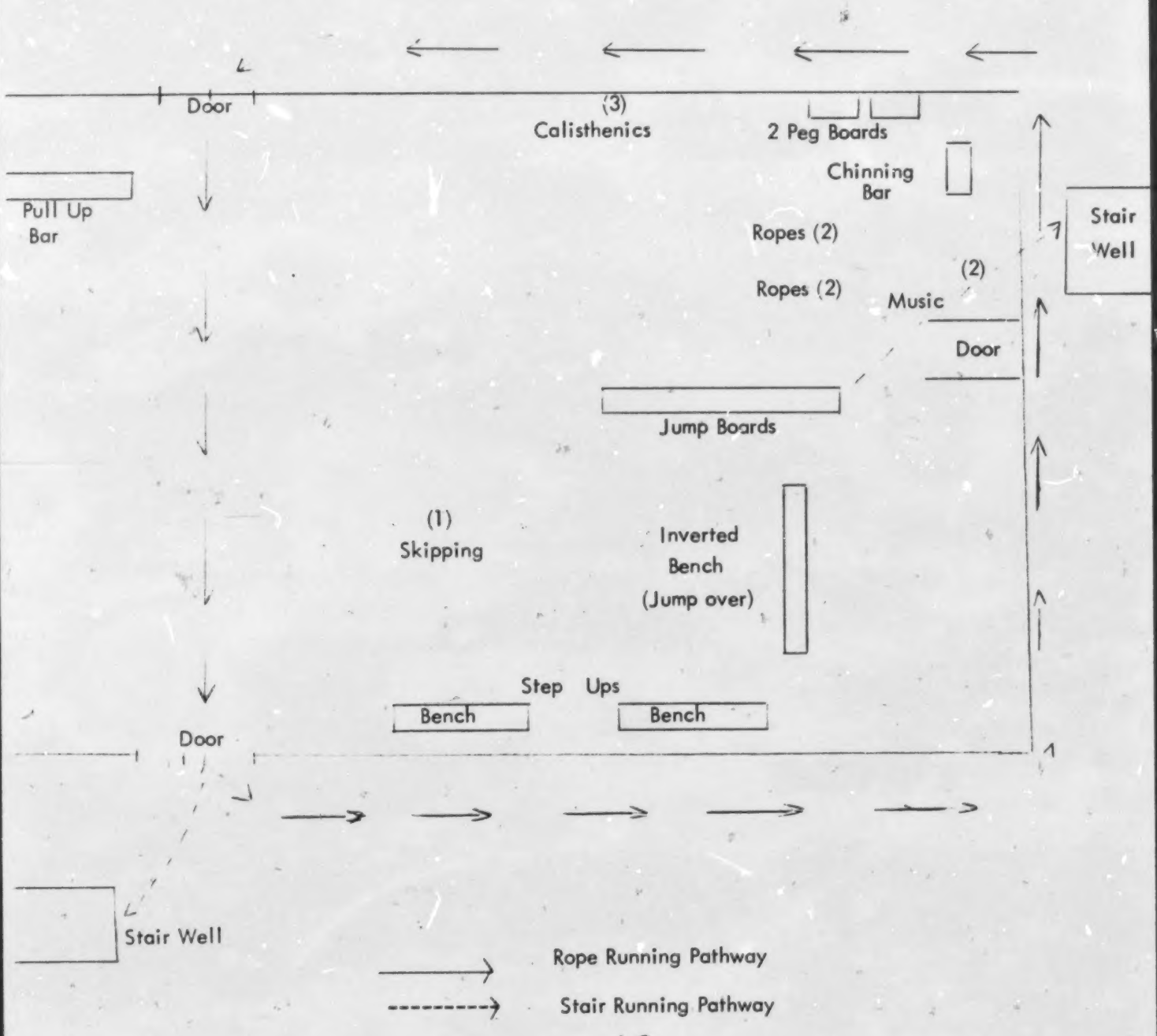
Each student started on the easy level of the particular circuit he was working on until he had progressed sufficiently to move up to the more difficult level.

While the students were participating in the circuit, taped music was continuously piped into the gymnasium by a high fidelity P.A. system. The music was chosen by the students.

At the end of each circuit the students would kneel on one knee, place their fingers on

their necks, and count the number of heart beats that occurred in the ten second period that the teacher clocked. All the students had been told that their heart rate should be twenty-five beats or greater in the ten second period if they wanted to improve their fitness level.

The following diagram illustrates the layout of the circuit.



All students started on the carousel run. Two benches were placed end to end approximately 3 feet apart. The students were required to run in a circle and jump over the bench each time it crossed his or her path. Everyone was forced to keep running by the individuals behind them. The next progression was an exercise executed with jump boards. These boards were easily constructed by putting 2 by 4 inch pieces of wood about three feet long on legs. The student was required to jump from side to side over the board. As he improved, inverted benches were used that were higher and made the student work harder.

The final progression was stair running. The students used the nearest stairs to the gymnasium and ran up and down three floors four or five times.

The skipping area started with stationary hoop or rope skipping. As the students became accustomed to this skill they began to skip backwards, cross the rope over while jumping and eventually ran through the gym and around the halls forming a large circular path to follow. The students could do three minutes of bench step ups instead of skipping. This exercise kept everyone very active for the required time limit.

The calisthenics area used exercises that would strengthen the upper body and abdomen. One corner of the gymnasium was designated for this station. Here there were 4 ropes that the students could hang from and eventually attempt to climb. There were chinning bars for pull ups and flexed arm hangs. There were two peg boards where the students could execute the flexed arm hang and climb by the use of the pegs up the board and back. A large floor area was available for sit ups, push ups, hand stands, feet stamping, krantz curls, leg lifts, etc.

RESEARCHER'S SUBJECTIVE OBSERVATIONS:

It took approximately one week before the students became oriented to the different exercises and rotation patterns.

The running station was the easiest to learn and it was well executed. The very nature of the exercises (i.e. carousel run) forced all students to keep active for the full three minutes. The jump boards forced the students to jump. Before these boards were built the students were required to jump back and forth over two lines, a distance of approximately eight inches. Many would only hop half of the time or slide from one foot to the other or hop a distance of only three inches. Therefore by putting a physical barrier before the student, the amount of work he had to do increased. The students showed visual signs of fatigue such as red faces, heavy breathing when they had completed this station.

The skipping station was an excellent general body conditioner. Once the student had mastered the skill of skipping he could continue the exercise for the three minute interval.

The calisthenics area seemed to be the poorest of the three stations. The students were

scattered all over the area. Some were trying to read the posters on the wall to see what exercise they should be doing or which one came next. Others would sit around, do ten to twenty repetitions of an exercise and then stop. Some would do the exercise correctly while others stood and watched them. Others pretended to do the exercise while talking amongst themselves. The teachers were constantly circulating, demonstrating to the students and encouraging, often pushing them to do a maximum number of repetitions of each exercise.

Finally, after a couple of months of frustration on both the students and teachers' parts, the calisthenics area was abandoned and the circuit only consisted of the running and skipping areas for a total time of six minutes.

This final circuit design worked very well. The students showed visual signs of physical output (reddened faces, puffing, perspiration) and fatigue. The circuit was unique in the fact that it can be utilized by any school, the equipment was very simple in design and could easily be incorporated into any physical education class. The music was chosen by the students and in the observers' and teachers' opinions was a significant motivational factor.

Observations were also made of the Physical Education classes in both Junior High schools. The following table compares several elements of the programs.

EXPERIMENTAL	CONTROL
1. FACILITIES	
1 double gym 1 activity room use of cafetorium	1 double gym 1 portable
2. STAFF	
3 male 2 female	3 male 3 female
3. TIME	
a) 50 minute periods b) students took gym 5/6 days all year	a) 40 minute periods b) students took gym for 2/3 of year every day, 1/3 of year took it 4/6 days
c) never went without fitness exercises even when studying health	c) no PE for 22 periods (had health)

Activities (over the 4 month period)

EXPERIMENTAL	CONTROL
d) 20 periods/cycle the students would participate for 10 periods/activity.	22 periods/cycle the student would participate for 22 periods/activity
1st Cycle	1st Cycle
Girls - Basketball (half girls) Boys - Wrestling (half boys) Co-ed Health (the other half) After 10 periods, they would switch	Grade 7 & 8 - dance, health Grade 7 & 8 Boys - Wrestling, Basketball Grade 9 - Coed Volley ball and Coed Health
2nd Cycle	
Week of Western Motor Ability Testing	
Girls - Jazz Dance)followed same pattern as Boys - Basketball)outlined in first cycle Co-ed Health)	Grade 7 & 8 Girls - dance, health Grade 7 & 8 Boys - wrestling, basketball Grade 9 girls - coed health,yoga Grade 9 Boys - basketball Coed volleyball
3rd Cycle	
Girls - Swedish Balls Boy - Okie Ball - Wt. Training Co-ed Health	Grade 7 & 8 Girls - volleyball, outdoor education Grade 7 & 8 Boys - Gymnastics, Health Grade 9 girls - coed health,volleyball Grade 9 boys - gymnastics Coed outdoor education
e) students physically active for 1) 10-14 min. in basketball 2) 10-14 min. in dance 3) 12 - 15 min. in wrestling.	e) students physically active for: 1) 4-5 min. in basketball 2) 13 - 16 min. in dance 3) 4-5 min. in wrestling

Note: The activities, listed in part (e) are non aerobic activities. In general the students' pulse rate would never reach 150 beats/min. and therefore little or no training effect would result.

CLASS SIZE

28 - 32 students	25 - 32 students

PART B

Data are organized and presented in the following four sections:

1. Description of boys and girls by age within each school for pre-and post-results in terms of height, weight, and percent body fat.

II. Aerobic Measures: for each measure, the mean and standard deviation for boys and girls for pre- and post-test in each age group within each school.

III. Additional Measures - mean and standard deviation for boys and girls within each age group on measures of grip strength and peak flow.

In each of these sections, two types of comparisons are made:

(i) for each subgroup, e.g. experimental boys age 12, a comparison is made between their pre-and post-scores to determine the extent of growth over the course of the year.

(ii) at each age level for boys and girls separately, a comparison is made between the gains for the experimental and control schools, to determine whether the aerobics program was more effective than the regular program.

IV. CAHPER Tests: for each measure, mean and standard deviation for boys and girls within each age group on the pre-test.

I. Height, Weight, Percent Body Fat

It is evident that at each age group*, there is little difference between the two schools in terms of average height and weight for both the pre- and the post-test scores (see Tables 1 & 2). As you would expect, average height and weight increase with age and at each age level there is a gain from the pre-test to the post-test.

Table 3 shows the average percent body fat for girls and boys in each school on both pre- and post-test.

There is little difference between the boys' pre-test scores in the experimental and control schools. However, on the post-test results the experimental boys at age 12 showed a significant increase in their values ($t = 3.0$, $df = 55$, $p < .01$) as compared with the pre-test, as did the control boys at ages 13 and 14. ($t = 2.5$, $df = 51$, $p < .05$; $t = 3.1$, $df = 50$, $p < .01$).

On the post-test, the experimental girls showed a significant increase in their scores from pre-to-post-test at ages 12 and 13 ($t = 3.0$, $df = 54$, $p < .01$; $t = 4.4$, $df = 51$, $p < .001$), while the control girls showed a significant increase at ages 13 and 14 ($t = 6.9$, $df = 51$, $p < .001$; $t = 3.0$ $df = 51$, $p < .01$).

It is interesting to note that for girls the average percent body fat figures increased with age while for boys they decreased with age.

---

* The sample of boys and girls in each school was divided into groups, based on their age as of September 30th., 1974.

TABLE 1

AVERAGE HEIGHT FOR BOYS AND GIRLS ON PRE-AND POST-TEST IN EACH SCHOOL

MEASUREMENT: HEIGHT (cm.)

BOYS							GIRLS				
PRE-TEST Mean	S.D.	N	POST-TEST Mean	S.D.	Gain Scores	AGE	PRE-TEST Mean	S.D.	N	POST-TEST Mean	S.D.	Gain Scores
						12						
150.8	6.6	56	154.6	7.3	3.8	Experimental	152.4	7.5	55	155.5	7.6	1.3
149.6	6.3	55	151.4	7.1	1.8	Control	154.8	6.6	48	156.0	6.4	1.2
						13						
158.4	7.6	52	162.7	7.7	4.3	Experimental	156.2	6.6	52	158.7	6.6	2.2
156.5	7.9	51	158.2	8.3	1.7	Control	157.1	6.6	51	157.5	7.2	.4
						14						
163.7	9.2	47	166.1	11.8	2.4	Experimental	160.7	6.6	50	162.1	6.7	1.4
166.0	8.9	51	168.1	8.2	2.1	Control	160.0	6.2	52	160.2	6.1	.2

TABLE 2

AVERAGE WEIGHT FOR BOTH BOYS AND GIRLS ON PRE-AND POST-TEST IN EACH SCHOOL

MEASUREMENT: WEIGHT (kg.)

BOYS							GIRLS				
PRE-TEST Mean	S.D.	N	POST-TEST Mean	S.D.	Gain Scores	AGE	PRE-TEST Mean	S.D.	N	POST-TEST Mean	S.D.	Gain Scores
						12						
43.7	8.8	56	45.3	7.8	1.6	Experimental	43.3	8.2	55	45.2	7.9	1.9
41.6	9.1	55	43.8	9.9	2.2	Control	46.1	6.6	48	47.8	6.0	1.7
						13						
48.0	9.1	52	51.1	9.6	3.1	Experimental	47.8	8.5	52	49.6	9.4	1.8
47.7	9.4	51	49.8	10.0	2.1	Control	48.2	7.3	51	49.2	8.3	1.0
						14						
50.2	10.2	47	53.2	10.1	3.0	Experimental	51.4	7.0	50	52.2	6.4	.8
53.2	9.0	51	57.5	10.1	4.3	Control	51.8	8.7	52	52.4	8.8	.6

TABLE 3

AVERAGE PERCENT BODY FAT MEASUREMENTS FOR BOTH SEXES
FOR PRE-AND POST-TEST IN BOTH SCHOOLS

MEASUREMENT: % BODY FAT

BOYS							GIRLS					
PRE-TEST Mean	PRE-TEST S.D.	N	POST-TEST Mean	POST-TEST S.D.	Gain Scores	AGE	PRE-TEST Mean	PRE-TEST S.D.	N	POST-TEST Mean	POST-TEST S.D.	Gain Scores
						12						
9.5	2.0	56	10.1**	2.8	.6	Experimental	10.6	2.7	55	11.3**	2.6	.7
9.6	3.6	55	9.8	3.5	.2	Control	11.5	2.4	48	12.2	2.1	.7
						13						
9.4	2.6	52	9.4	2.6	0	Experimental	11.5	2.6	52	12.6**	3.5	1.1
9.5	3.3	52	10.2*	3.5	.7	Control	11.6	2.3	52	12.7**	2.6	1.1
						14						
8.4	1.9	49	8.8	2.2	.4	Experimental	12.0	2.4	50	12.6**	2.2	.6
8.3	1.6	51	9.4**	3.4	1.1	Control	12.1	2.5	52	12.7**	2.3	.6

* Pre-Post Differences significant, $p \leq .05$

** Pre-Post Differences significant, $p \leq .01$

II. Aerobic Measures

As discussed earlier, four measures were used to estimate aerobic fitness, i.e. PWC_{170}, Astrand, 12 minute run and the 600 yard run.

PWC_{170}

The mean PWC_{170} values corrected for individual body weight are presented in Table 4 for both girls and boys at the experimental and control schools for all three age levels.

The boys' scores tended to increase with age on both pre-and post-tests. The post-test scores in the experimental school were significantly higher than the pre-test scores at all three age levels*, whereas the control school showed no gain or a decrease in their mean post-test scores as compared with the pre-test.

Further, the average gain scores for experimental boys were significantly higher at all three age levels than those for control boys.

The results for girls, on the other hand were not as clear cut. There was no trend for their scores to increase with age and only a slight tendancy for performance to improve on the post-test.

As there was a significant difference between the pre-test scores for experimental and control girls at ages 13 and 14, analyses of covariance were carried out on the post-test scores, using the pre-test as the covariate. At both age levels, there were no significant differences between the experimental and control groups on the post-test.

In summary, experimental boys at all three age levels showed significant gains when compared to the gains of the control school boys, while there was no difference between the performance of experimental and control girls.

---

* Age 12: $t = 1.8$, $df = 52$, $p < .05$
Age 13: $t = 3.3$, $df = 46$, $p < .01$
Age 14: $t = 2.8$, $df = 47$. $p < .01$

TABLE 4

AVERAGE $PWC_{170}/kg.$ VALUES FOR BOTH SEXES ON PRE- AND POST-TEST IN EACH SCHOOL

MEASUREMENT: $PWC_{170}/kg.$

BOYS							GIRLS					
PRE-TEST Mean	S.D.	N	POST-TEST Mean	S.D.	Gain Scores	AGE	PRE-TEST Mean	S.D.	N	POST-TEST Mean	S.D.	Gain Scores
12.7	3.4	53	13.5*	3.0	+ .8+	12 Experimental	11.4	2.7	52	11.4	2.5	0
12.8	3.3	53	12.8	2.6	0	Control	10.7	2.5	47	10.4	1.9	- .3
12.4	2.6	47	13.7**	2.9	1.3++	13 Experimental	10.1	2.3	49	10.6	2.2	
13.3	3.1	51	13.0	2.4	- .3	Control	9.8	2.5	50	9.9	3.1	
13.0	2.7	48	14.3**	3.0	1.3++	14 Experimental	10.5	2.6	47	10.7	2.0	
13.5	3.1	51	13.3	2.8	- .2	Control	9.4	2.2	52	9.8	2.2	

* Differences significant, $p < .05$

** Differences significant, $p < .01$

\+ Gain score differences significant, $p < .05$

++ Gain score differences significant, $p < .01$

Astrand/kg

On the post-test, average aerobic power scores (see Table 5) for experimental boys were significantly higher than their pre-test scores at ages 13 and 14 ($t = 1.9$, $df = 49$, $p \leq .05$; $t = 1.7$, $df = 47$, $p < .05$), while post-test scores for the control school were lower than the pre-test values at all three age levels.

At ages 13 and 14, the gains for experimental boys were significantly higher than those for control boys ($t = 2.6$, $df = 99$, $p < .01$; $t = 2.4$, $df = 94$, $p < .01$) and although there was no significant difference between the gains at age 12, they were in the predicted direction.

At age 13, post-test scores for experimental girls were significantly higher than their pre-test scores ($t = 2.4$, $df = 48$, $p < .01$) while at age 14, there was no difference between pre- and post-test scores. For control girls, there were no differences between their pre- and post-test scores at either age 13 or 14.

There was a significant difference between the pre-test scores for 12 year old girls in the two schools, therefore an analysis of covariance was conducted on the post-test scores using the pre-test as covariate. The results of this analysis showed a significant difference in favour of the experimental school ($F = 6.52$, $df = 1,97$, $p \leq .05$).

As well, at age 13, the average gain for experimental girls was significantly higher than that for the control group ($t = 1.67$, $df = 96$, $p < .05$).

In summary, the pattern of results for the aerobic power scores indicates a tendency for the experimental students, both boys and girls, to show higher average gains than the control students.

12 Minute Run

The pattern of results for both boys and girls on the 12 minute run (see Table 6) indicated a tendency for the experimental students to improve their performance from pre- to post-test by approximately one-tenth of a mile. These differences were significant for all boys and girls except 14 year old girls, who showed no gain from fall to spring.

The performance of the control students, on the other hand, tended to decrease significantly from fall to spring.

The results from this measure provide the clearest evidence of the effectiveness of the experimental school aerobic program as compared with a typical physical education program.

TABLE 5

AVERAGE ASTRAND/kg VALUES FOR BOYS AND GIRLS
PRE-AND-POST TEST IN EACH SCHOOL

MEASUREMENT: ASTRAND/kg

BOYS							GIRLS					
PRE-TEST Mean	S.D.	N	POST-TEST Mean	S.D.	Gain Scores	AGE	PRE-TEST Mean	S.D.	N	POST-TEST Mean	S.D.	Gain Scores
						12						
42.1	10.5	55	43.6	8.7	1.5	Experimental	42.4	10.9	53	42.7	8.6	
43.1	9.3	54	42.9	8.0	-.2	Control	38.4	7.1	47	37.7	5.8	
						13						
40.9	8.5	50	43.3*	8.9	2.4++	Experimental	36.8	7.2	49	39.0**	6.9	2.2+
42.7	9.1	51	41.4	7.8	- 1.3	Control	35.9	8.4	49	35.8	7.1	-0.1
						14						
41.5	7.9	48	43.5*	7.3	2.0++	Experimental	38.1	8.9	50	38.2	5.9	.1
42.2	7.9	48	40.0*	6.9	-2.2	Control	35.5	8.7	52	35.2	6.7	- .3

* Pre-Post Differences Significant, $p < .05$
** Pre-Post Differences Significant, $p < .01$
\+ Gain Score Differences Significant, $p < .05$
++ Gain Score Differences Significant, $p < .01$

TABLE 6

AVERAGE 12 MINUTE RUN VALUES FOR BOTH SEXES ON
PRE-AND POST-TEST IN BOTH SCHOOLS

MEASUREMENT: 12 MINUTE RUN (Miles)

BOYS							GIRLS					
PRE-TEST Mean	S.D.	N	POST-TEST Mean	S.D.	Gain Scores	AGE	PRE-TEST Mean	S.D.	N	POST-TEST Mean	S.D.	Gain Scores
1.4	.2	45	1.5**	.2	.1 ++	12 Experimental	1.3	.2	41	1.4**	.2	.1 ++
1.5	.2	46	1.4***	.2	- .1	Control	1.3	.2	41	1.1***	.2	- .2
1.5	.3	43	1.6**	.2	.1++	13 Experimental	1.2	.2	45	1.3**	.1	.1 ++
1.5	.2	48	1.5	.2	0	Control	1.3	.2	49	1.2***	.2	- .1
1.6	.2	41	1.7**	.1	.1++	14 Experimental	1.3	.2	39	1.3	.2	0 ++
1.6	.2	47	1.4***	.2	-.2	Control	1.4	.2	48	1.2***	.2	- .2

** Pre-post increase, significant, $p < .01$

*** Pre-post decrease significant, $p < .01$

++ Gain score differences significant, $p < .01$

600 Yard

Table 7 shows the results for the 600 yard run. The reader should note that although scores decrease from pre - to post-test, this represents improved performance as the score for the 600 yard run is time in seconds.

The experimental boys at all three age groups improved their performance significantly from pre - to post- test*. Control boys at ages 12 and 14 also showed significant improvement in their performance ($t = 3.0$, $df = 42$, $p < .01$; $t = 1.7$, $df = 42$, $p < .05$). The reader will note that although the average gain for 13 year old control students is larger than that for 14 year old control boys, it is not significant. This can be attributed to the larger standard deviation on the post-test and the lower correlation between pre- and post-scores.

At all three age levels, there were no significant differences between average gains for experimental boys and those for control boys.

Girls, both experimental and control, did not improve their performance significantly from pre - test to post-test.

Although PWC_{170}, Astrand, 12 minute run and 600 yard run all provide estimates of aerobic fitness, it is obvious from the slightly different patterns of results on the four measures that there is not a uniformly high degree of relationship among them.

The following two tables show the correlations for each of boys (Table 8) and girls (Table 9) among the four aerobic measures on both pre- and post-test.

The reader will note that although correlations of PWC_{170}, Astrand and 12 minute measure with the 600 yard run are negative, this reflects the fact that the score for the run is "time in seconds", so that the faster a person runs, the lower his score, while the PWC_{170}, Astrand and 12 minute run scores increase as the student performs more work.

For both boys and girls, PWC_{170}/kg showed the strongest relationship with Astrand/kg.

Age 12: $t = 3.8$, $df = 40$, $p < .01$
Age 13: $t = 2.7$, $df = 46$, $p < .01$
Age 14: $t = 3.8$, $df = 37$, $p < .01$

TABLE 7

AVERAGE 600 YARD RUN FOR GIRLS AND BOYS ON PRE-AND POST-TEST SCORES IN BOTH SCHOOLS

MEASUREMENT: 600 YARD RUN (Seconds)

BOYS							GIRLS					
PRE-TEST Mean	S.D.	N	POST-TEST Mean	S.D.	Gain Scores	AGE	PRE-TEST Mean	S.D.	N	POST-TEST Mean	S.D.	Gain Scores
						12						
145.3	17.9	41	139.7**	15.9	-5.6	Experimental	144.2	10.8	40	143.0	24.6	-1.2
136.8	15.0	43	132.6**	12.2	-4.2	Control	153.3	18.2	46	152.8	15.1	-0.5
						13						
138.3	12.7	47	133.6**	15.6	-4.7	Experimental	148.7	13.0	42	146.7	13.7	-2.0
136.0	14.3	49	132.8	19.3	-3.2	Control	147.1	10.6	48	149.1	17.7	+2.0
						14						
129.1	10.8	38	123.6**	10.9	-5.5	Experimental	143.1	10.4	37	142.7	10.0	-0.4
126.5	13.5	43	124.0*	12.8	-2.5	Control	146.2	15.1	50	145.1	16.1	-1

* Pre- Post-Differences significant, $p < .05$

** Pre-Post Differences significant, $p < .01$

TABLE 8

CORRELATIONS AMONG THE AEROBIC MEASURES
PRE-AND POST-TEST SCORES FOR BOYS

	PWC_{170}/kg	Astrand/kg	12 Minute	600 Yard
PWC_{170}/kg		.82	.32	-.29
Astrand/kg	.84		.29	-.19
12 Minute	.31	.26		-.63
600 Yard	- .13	- .07	- .24	

Pre-Test Values - Top Half
Post-Test Values - Bottom Half

TABLE 9

CORRELATIONS AMONG THE AEROBIC MEASURES
PRE-AND POST-TEST SCORES FOR GIRLS

	PWC_{170}/kg	Astrand/kg	12 Minute	600 Yard
PWC_{170}/kg		+.82	+.23	-.24
Astrand/kg	+.89		+.24	-.30
12 Minute	+.44	+.48		-.54
600 Yard	-.26	-.23	-.47	

Pre-Test Values - Top Half

Post-Test Values - Bottom Half

III. Additional Measures

Two other measures were included in the test battery as a further indication of each individual's physical fitness, grip strength and peak expiratory flow.

Grip Strength

For experimental boys at ages 12 and 14 their average grip strength scores decreased significantly from pre - to post-test ($t = 1.7$, $df = 55$, $p \leq .05$; $t = 2.4$, $df = 46$, $p < .01$), while 13 year old boys did not change from pre- to post-test. The control boys, on the other hand, showed significant improvement at all three age levels from pre- to post-test.*

Among the girls, experimental girls at ages 13 and 14, showed significant decreases from pre- to post-test ($t = 5.0$, $df = 51$, $p < .01$; $t = 2.8$, $df = 49$, $p \leq .01$), while control girls at ages 12 and 13 showed significant improvements ($t = 5.0$, $df = 47$, $p < .01$; $t = 2.9$, $df = 50$, $p < .01$).

In terms of this measure, control students, both boys and girls, consistently obtained significantly higher average gains than experimental students.

Peak Expiratory Flow

Average peak flow values (see Table 11) for all subgroups, both experimental and control were significantly higher on the post-test as compared with the pre-test. In addition, there were no differences between experimental and control groups in terms of average gains.

CAHPER Tests **

The pre-test results of the six CAHPER tests described earlier in the report were analyzed for both boys and girls at each of the three age levels.

---

* Age 12: $t = 4.1$, $df = 54$, $p < .01$
Age 13: $t = 5.8$, $df = 50$, $p < .01$
Age 14: $t = 5.2$, $df = 50$, $p < .01$

** The following is an abbreviation of the detailed norms report which is available under separate cover upon request.

TABLE 10

AVERAGE GRIP SGRENGTH VALUES FOR BOTH BOYS AND GIRLS
ON PRE-AND POST-TEST-BOTH SCHOOLS

MEASUREMENT: GRIP STRENGTH

BOYS							GIRLS					
PRE-TEST			POST-TEST				PRE-TEST			POST-TEST		
Mean	S.D.	N	Mean	S.D.	Gain Scores	AGE	Mean	S.D.	N	Mean	S.D.	Gain Scores
						12						
55.7	11.9	56	53.9*	11.4	-1.8	Experimental	48.5	9.7	55	48.1	10.7	-.4
52.7	10.0	55	56.6**	10.7	3.9++	Control	50.0	12.0	48	56.0**	10.8	6.0++
						13						
64.8	15.5	51	66.5	17.07	1.7	Experimental	53.8	10.8	52	46.3**	14.3	- 7.5
64.0	16.3	51	72.1**	19.1	8.1++	Control	53.5	12.7	51	57.0**	13.2	3.5++
						14						
78.0	18.2	47	74.0**	18.5	-4.0	Experimental	58.5	8.7	50	54.9**	11.4	-3.6
78.9	21.5	51	87.3**	19.7	8.4++	Control	57.7	10.6	52	64.2**	10.5	6.5++

* Pre-Post Differences significant, $p < .05$

** Pre-Post Differences significant, $p < .01$

++ Gain score differences significant, $p < .01$

TABLE 11

AVERAGE PEAK FLOW VALUES FOR BOTH SEXES ON PRE-AND POST-TEST
BOTH SCHOOLS

MEASUREMENT: PEAK EXPIRATORY FLOW (Litres/Minute)

BOYS							GIRLS					
PRE-TEST		N	POST-TEST		Gain Scores	AGE	PRE-TEST		N	POST-TEST		Gain Scores
Mean	S.D.		Mean	S.D.			Mean	S.D.		Mean	S.D.	
						12						
339.5	51.4	56	358.7**	54.8	19.2	Experimental	352.2	45.6	55	378.2**	56.7	26.0
331.3	52.6	55	350.7**	69.3	19.4	Control	351.1	48.1	48	372.6**	51.7	21.5
						13						
378.7	57.4	52	411.1**	68.5	32.4	Experimental	371.2	46.4	52	398.8**	53.0	27.6
376.4	64.8	51	406.9**	73.7	30.5	Control	383.6	57.5	52	407.9	53.8	24.3
						14						
418.8	73.6	47	438.4*	95.4	19.6	Experimental	392.1	40.4	50	409.9**	38.7	17.8
419.6	59.2	51	445.0**	60.4	25.4	Control	396.1	46.0	52	405.8*	39.2	9.7

* Pre-Post Differences significant, $p < .05$
** Pre-Post Differences significant, $p < .01$

TABLE 12

MEAN SIT UPS AND LONG JUMP VALUES FOR GIRLS' IN EACH SCHOOL

EXPERIMENTAL							CONTROL					
SIT UPS			LONG JUMP			AGE	SIT UPS			LONG JUMP		
Mean	S.D.	N	Mean	S.D.	N		N	Mean	S.D.	N	Mean	S.D.
36.7	8.7	79	67.8***	6.4	79	12	78	37.6	7.8	78	62.6***	6.8
33.4***	10.1	102	68.7***	8.0	103	13	91	37.9***	8.2	91	64.8***	8.2
35.6	9.4	64	69.9**	7.9	67	14	69	38.0	8.3	69	66.5**	9.1

** Differences Significant, $p \leq .01$
*** Differences Significant, $p \leq .001$

Table 12 shows the mean scores on the sit up and standing long jump subtests for girls in each school. The mean sit up values are not significantly different for 12 and 14 year olds, but are significantly different for 13 year olds ($p < .001$). The experimental school has significantly higher average scores on the long jump than the control school, at all age levels. One possible explanation for these differences pertains to the floor in each school. The experimental school's floor was spongy and gave more spring to those who were jumping, whereas those in the control school had to jump on a cement tiled floor.

TABLE 13

MEAN SIT UPS AND LONG JUMP VALUES FOR BOYS
IN EACH SCHOOL

EXPERIMENTAL							CONTROL					
SIT UPS			LONG JUMP			AGE	SIT UPS			LONG JUMP		
Mean	S.D.	N	Mean	S.D.	N		N	Mean	S.D.	N	Mean	S.D.
37.9**	10.1	68	67.1	6.9	72	12	75	42.1**	10.1	76	65.3	6.9
40.9	9.1	78	71.2**	8.3	81	13	76	41.6	8.9	75	67.9**	8.6
43.9	7.4	62	78.4***	8.9	64	14	73	42.2	8.2	72	73.0***	8.6

** Differences Significant, $p < .01$
*** Differences Significant, $p < .001$

Table 13 presents the mean scores for sit ups and the long jump for boys in each school. With the exception of the 12 year olds, there were no significant differences between the schools in terms of the sit up average scores. However, 12 year old boys in the control school completed significantly more sit ups on the average than 12 year old boys in the experimental school. Again the significantly higher values for the long jump in the experimental school could be due to the type of floor. For both measures there is an increase with age in the values described.

TABLE 14

MEAN SIT UPS AND LONG JUMP VALUES FOR BOTH SCHOOLS COMBINED

ALL BOYS						ALL GIRLS				
SIT UPS		LONG JUMP			AGE		SIT UPS		LONG JUMP	
Mean	S.D.	Mean	S.D.	N		N	Mean	S.D.	Mean	S.D.
40.1	10.2	66.2	7.0	148	12	157	37.2	8.3	65.3	7.1
41.3	9.0	69.7	8.6	157	13	194	35.5	9.5	66.9	8.2
43.0	7.9	75.6	9.2	137	14	136	36.9	8.9	68.2	8.7

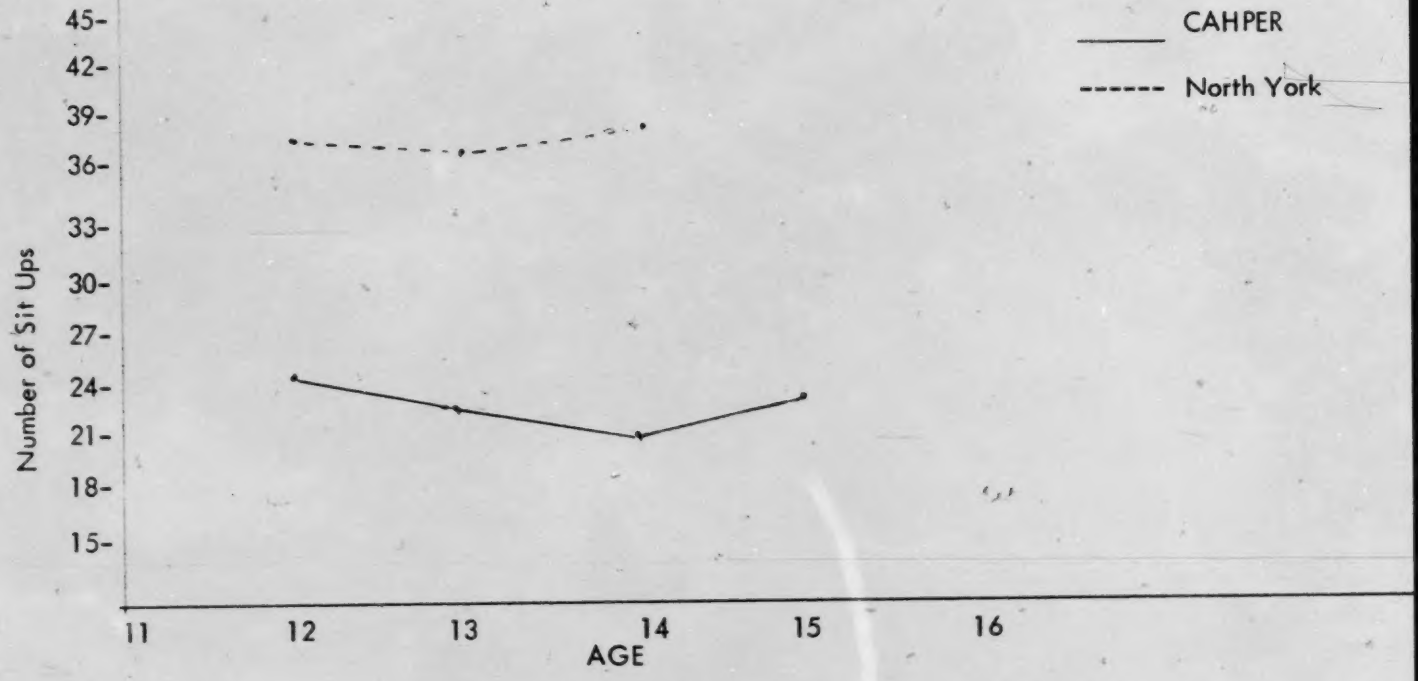
Table 14 gives a representation of the mean scores for sit ups and the long jump for all girls and all boys in both schools. The boys' values for both measures are higher than those for the girls. The mean sit up values for the boys show a definite increase with age whereas the mean sit up values for girls show a fluctuation at the different age brackets.

Graphs 1 and 2 show the mean number of sit ups for females and males respectively from the North York schools, as compared to the Canadian norms. In both graphs, the average values obtained by the students in our sample are significantly greater than those of the Canadian sample, beyond the .001 level of probability.

Graphs 3 and 4 illustrate the mean number of inches jumped by females and males respectively in the North York schools, as compared to the Canadian norms. Again the North York results are significantly higher for both males and females, beyond the .001 level of probability.

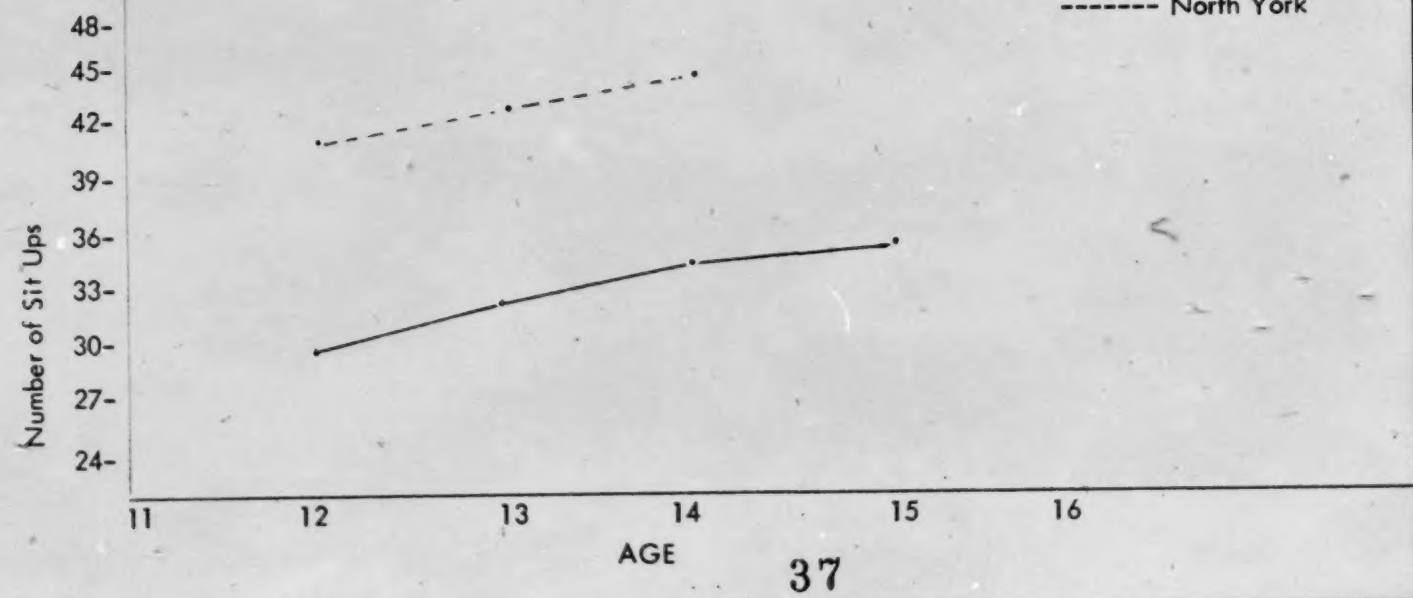
GRAPH 1

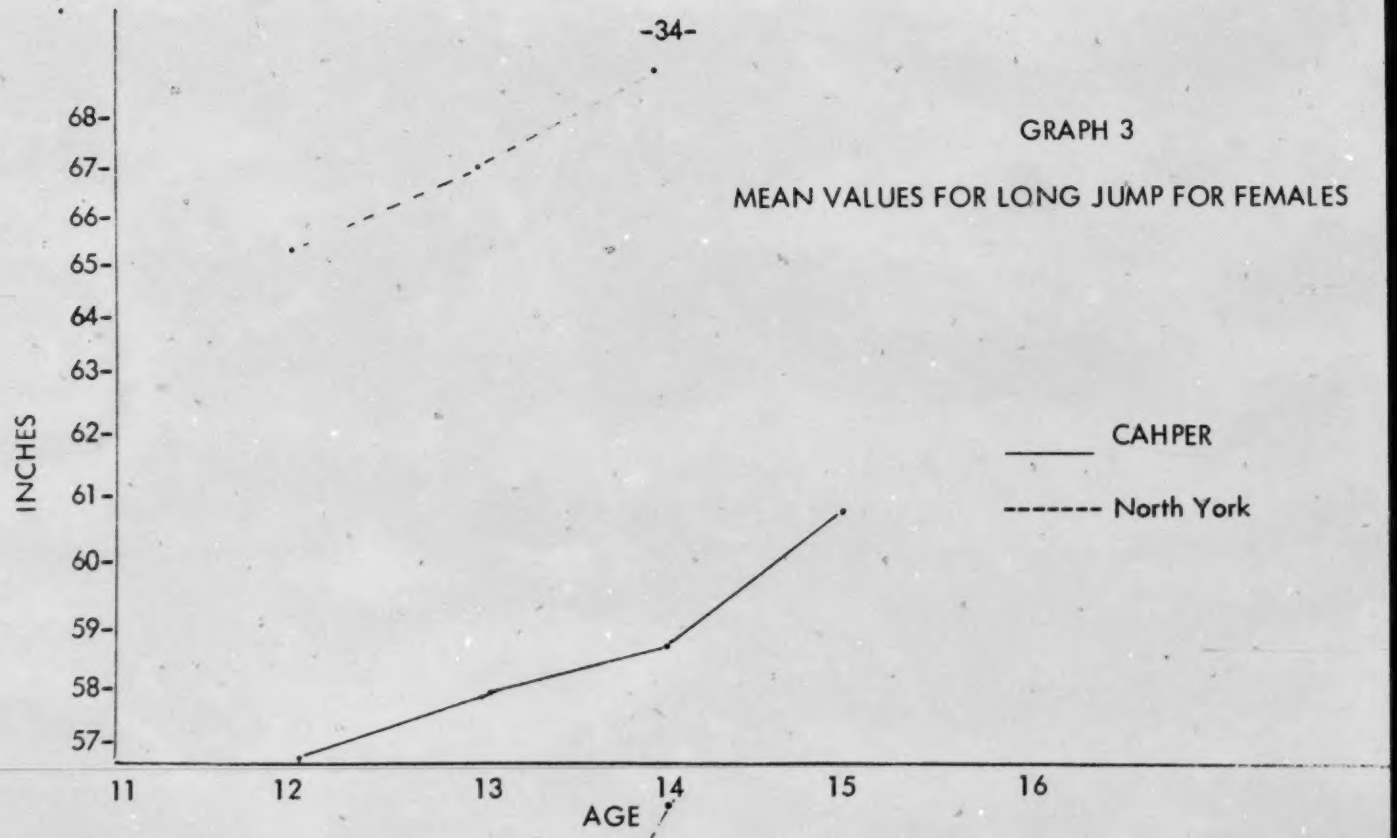
MEAN SIT UP VALUES FOR FEMALES



GRAPH 2

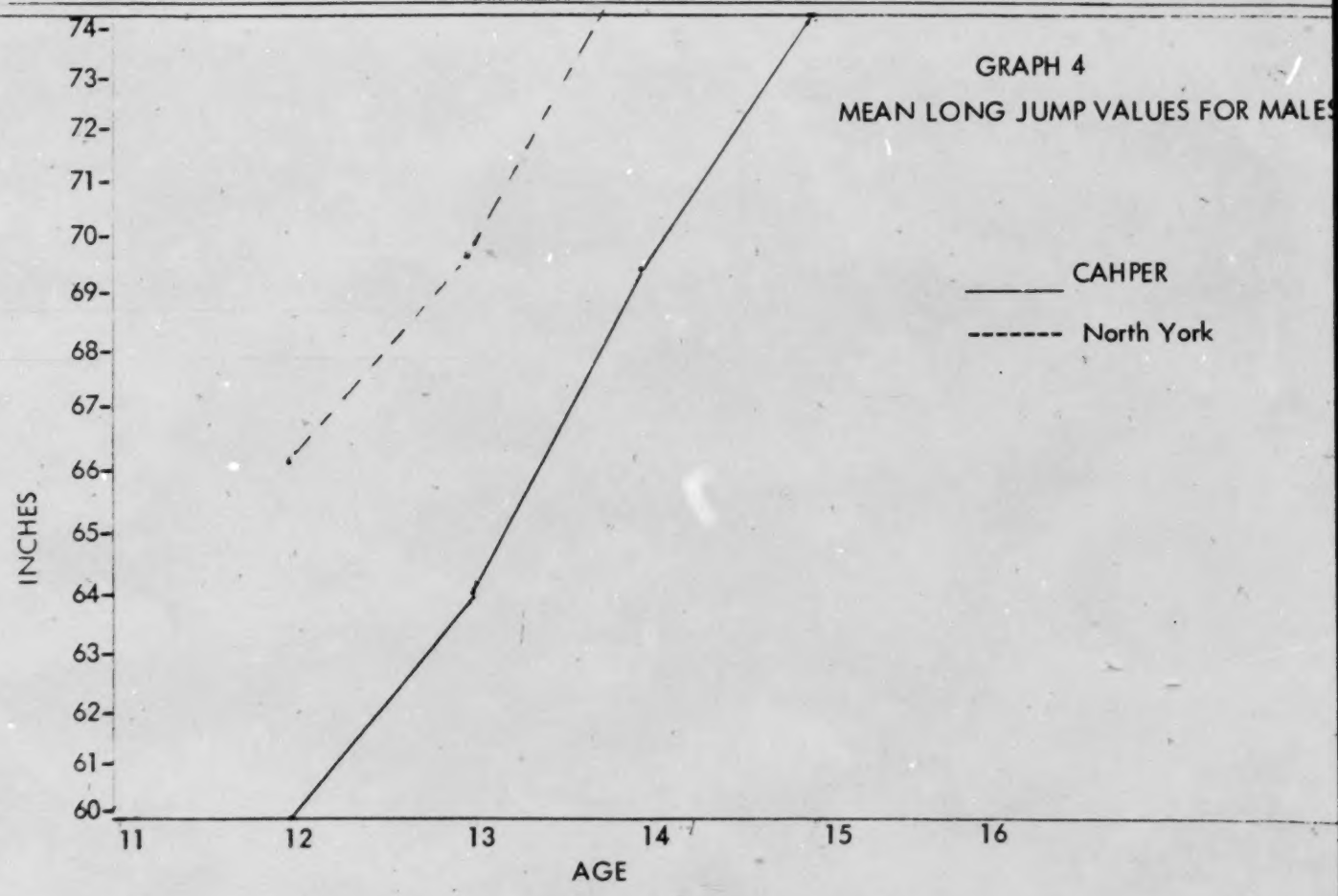
MEAN SIT UP VALUES FOR MALES





GRAPH 3

MEAN VALUES FOR LONG JUMP FOR FEMALES



GRAPH 4

MEAN LONG JUMP VALUES FOR MALES

TABLE 15

MEAN FLEXED ARM HANG VALUES FOR GIRLS
IN EACH SCHOOL

F.A.H.(G) = chin level
F.A.H. (B) = eye level

EXPERIMENTAL								CONTROL		
F.A.H. (G)			F.A.H. (B)			AGE	N	F. A. H. (G)	F. A. H. (B)	
Mean	S.D.	N	Mean	S.D.	N				Mean	S.D.
59.1	33.2	76	24.0	15.4	79	12	78	None Available	25.2	18.4
44.3	26.5	99	23.5	15.7	103	13	91		24.0	17.9
46.0	20.0	64	24.7	16.4	67	14	69		27.9	18.5

Table 15 shows mean flexed arm hang values for girls in each school. At the experimental school, the girls were asked to hold themselves at both chin and eye level. It is evident from looking at the results that the mean values at chin level are much higher than those values obtained at eye level. Looking at both schools, the mean values at eye level are very similar and show a slight tendency to increase with age.

TABLE 16

MEAN FLEXED ARM HANG VALUES FOR MALES
AT EACH SCHOOL

F.A.H. (G) = chin level
F.A.H. (B) = eye level

EXPERIMENTAL							CONTROL		
F.A.H.(G) Mean	S.D.	N	F.A.H.(B) Mean	S.D.	N	AGE	N	F.A.H. (G)	F.A.H. (B) Mean	S.D.
52.6***	28.6	68	32.6	16.9	72	12	73	None Available	47.0***	24.2
60.0	32.6	80	41.0	21.7	81	13	72		44.9	24.8
75.0	24.8	63	52.3	22.8	64	14	71		48.3	23.0

*** Difference significant $p < .001$

Table 16 shows the mean flexed arm hang values for males in each school. Again, in the experimental school, the mean arm hang values at chin level were much higher than those readings obtained at eye level. Boys in the control school show a significantly higher initial mean value at age 12 than boys in the experimental school, but tend to remain at this level with only slight increases up to age 14. In the experimental school, the increase is very definite with age and at 14 years the mean value surpasses that of boys in the control school, although the difference is not significant.

TABLE 17

MEAN F.A.H. (EYE) VALUES FOR BOTH SCHOOLS COMBINED

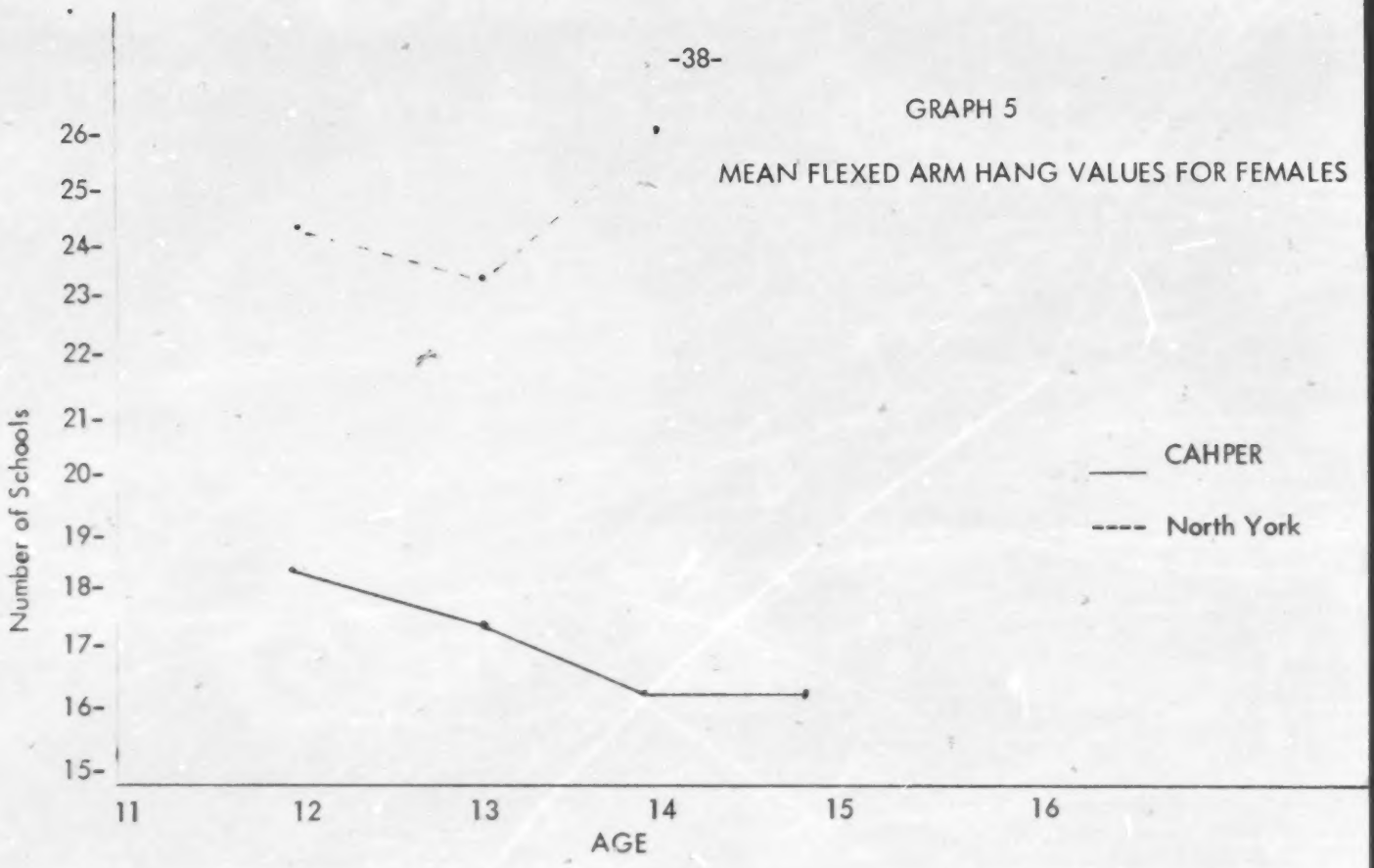
ALL BOYS F.A.H.(B) Mean	S.D.	N	AGE	N	ALL GIRLS F.A.H.(B) Mean	S.D.
39.9	22.1	148	12	157	24.6	17.0
42.9	23.3	157	13	194	23.8	16.8
50.2	23.0	137	14	136	26.4	17.5

Table 17 shows the mean flexed arm hang at eye level for all girls and all boys in both schools. The values tend to increase with age in both sexes, with the mean values for the boys being much higher than those for girls.

Graphs 5 and 6 illustrate the mean flexed arm hang scores for females and males respectively for both schools, compared to Canadian norms. Females (Graph 5) at all age levels show a significantly greater strength in this particular measure than those of the norm sample ($p < .001$). The males (Graph 6) are only slightly higher in their readings and follow a similar linear increase to the Canadian norms up to age 14.

GRAPH 5

MEAN FLEXED ARM HANG VALUES FOR FEMALES



GRAPH 6

MEAN FLEXED ARM HANG VALUES FOR MALES

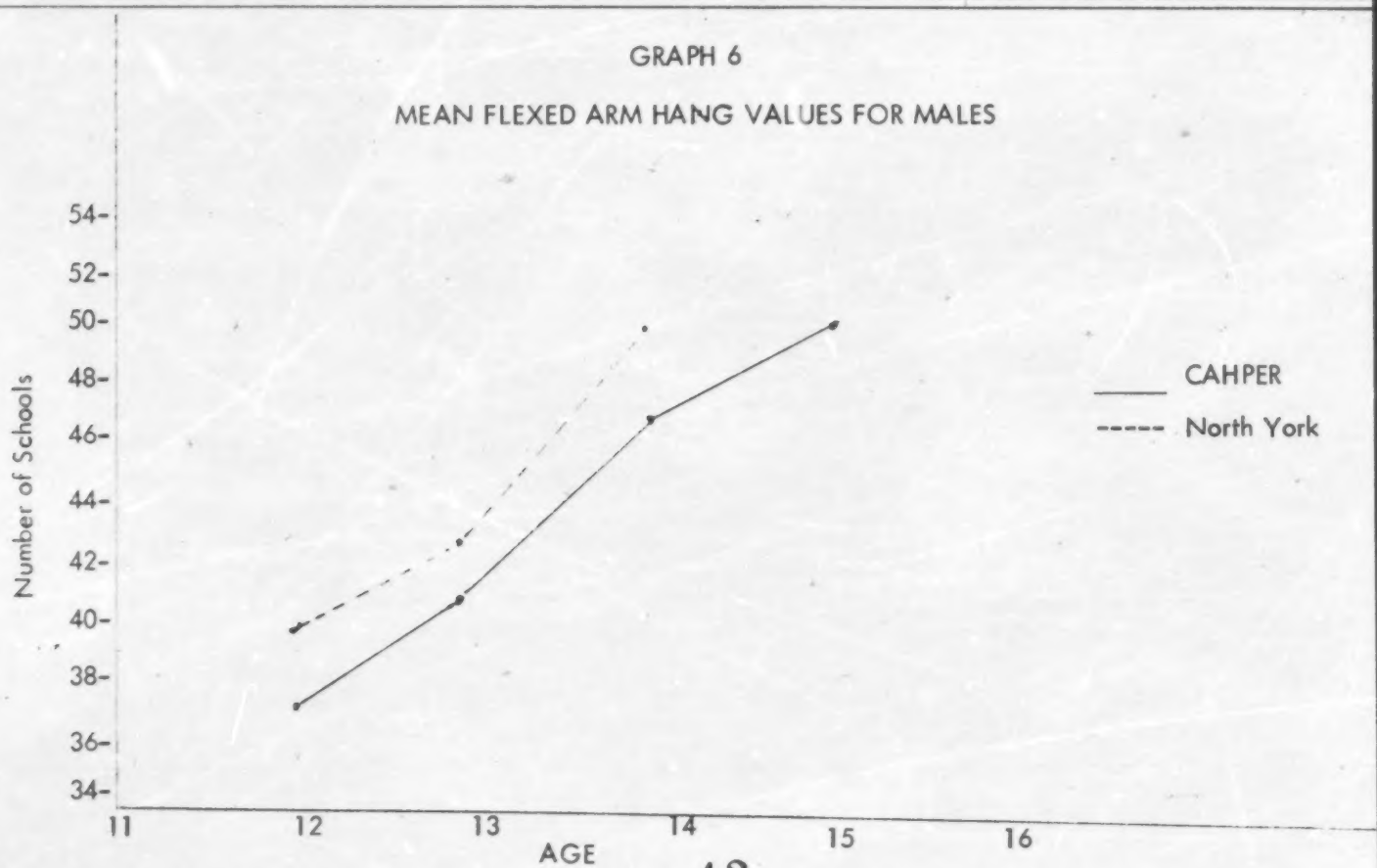


TABLE 18

MEAN AGILITY AND 50 YARD RUN VALUES FOR GIRLS IN EACH SCHOOL

EXPERIMENTAL							CONTROL					
Agility Run (Sec.)			50 Yard (Sec.)			AGE	Agility Run (Sec.)			50 Yard (Sec.)		
Mean	S.D.	N	Mean	S.D.	N		N	Mean	S. D.	N	Mean	S.D.
11.6***	0.7	79	8.2***	0.4	78	12	77	12.1***	1.0	78	7.7***	0.5
11.7	1.3	101	8.1***	0.6	98	13	91	11.9	1.1	91	7.6***	0.6
11.5	0.7	65	8.0***	0.5	62	14	69	11.5	0.8	69	7.6***	0.5

*** Differences significant, $p < .001$

Table 18 shows the mean agility and 50 yard run values for girls in each school. The mean values for the agility run are similar for the 13 and 14 year olds at both schools and decrease with age. At 12 years, there is a significant difference between the two schools. The mean values for the 50 yard run are significantly higher in the experimental school, than in the control, but in both schools there is a decrease with age, indicating that the older you get the faster you run.

TABLE 19

MEAN AGILITY AND 50 YARD RUN VALUES FOR MALES
IN EACH SCHOOL

EXPERIMENTAL							CONTROL					
Agility Run (Sec.)			50 Yard (Sec.)			AGE	Agility Run (Sec.)			50 Yard (Sec.)		
Mean	S.D.	N	Mean	S.D.	N		N	Mean	S.D.	N	Mean	S.D.
11.6	0.9	63	8.1**	0.5	67	12	73	11.3	0.9	75	7.8**	0.6
11.0	0.7	77	7.8	0.5	69	13	74	11.2	0.8	75	7.7	0.4
10.5**	0.5	63	7.3	0.5	59	14	73	11.0**	1.3	73	7.3	0.5

** Differences significant, $p \leq .01$

A tabular representation of the mean scores for agility and 50 yard run for boys in each school is shown above. Mean values for the agility run show little differences between schools at ages 12 and 13, however there is a significant difference at age 14. The mean 50 yard values are similar between 13 and 14 year olds at both schools, however there is a significant difference at age 12 $p < .01$. As was also demonstrated by the girls in Table 18, both the mean values for the agility run and the 50 yard run decrease with age.

TABLE 20

MEAN AGILITY AND 50 YARD RUN VALUES FOR BOTH SCHOOLS COMBINED

ALL BOYS						ALL GIRLS				
Agility Run (Sec.)		50 Yard (Sec.)			AGE		Agility Run(Sec.)		50 Yard(Sec.)	
Mean	S.D.	Mean	S.D.	N		N	Mean	S.D.	Mean	S.D.
11.5	1.0	8.0	0.6	148	12	157	11.9	0.9	8.0	0.6
11.2	0.8	7.8	0.5	157	13	194	11.8	1.3	7.9	0.7
10.8	1.1	7.3	0.5	137	14	136	11.5	0.8	7.8	0.6

Table 20 shows the mean agility and 50 yard run values for all girls and all boys in both schools. The agility run and the 50 yard run values for both sexes decrease with age, however the mean values of the boys are less than those obtained for the girls.

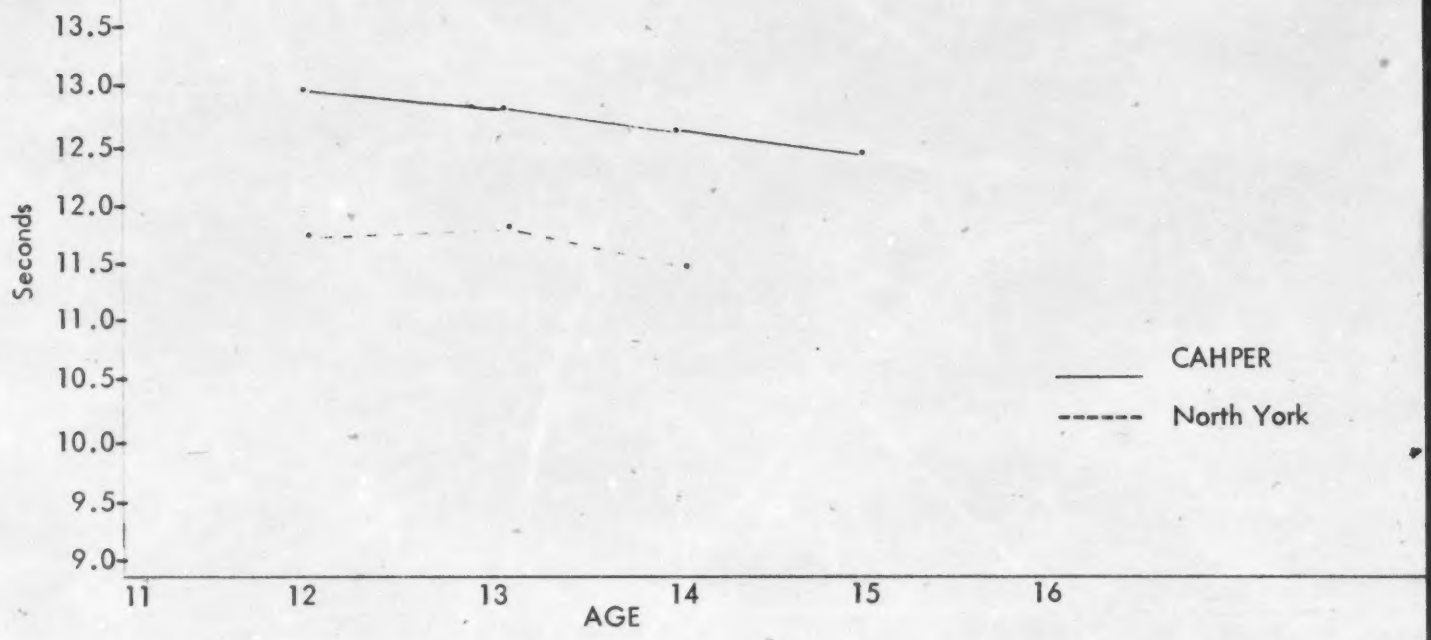
Graphs 7 and 8 illustrate the mean agility run values for females and males respectively for the experimental and control schools combined, and those of the Canadian norms. The mean values for both boys and girls in the North York sample are significantly lower ($p < .001$) than those of the Canadian sample indicating a faster time in completing the run.

Graphs 9 and 10 show the mean 50 yard run values for females and males respectively for both schools as compared to the Canadian norms.

Again, North York average scores are significantly better than the established norms ($p < .001$).

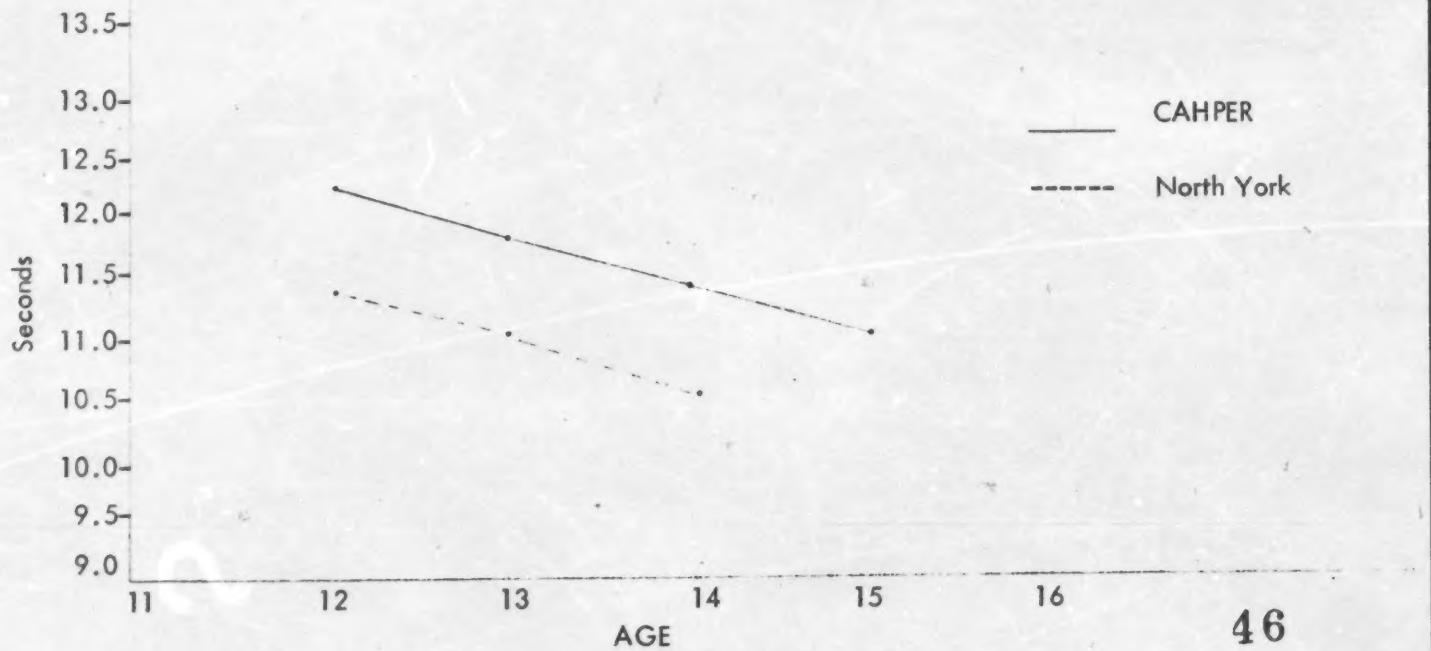
GRAPH 7

MEAN AGILITY RUN VALUES FOR FEMALES



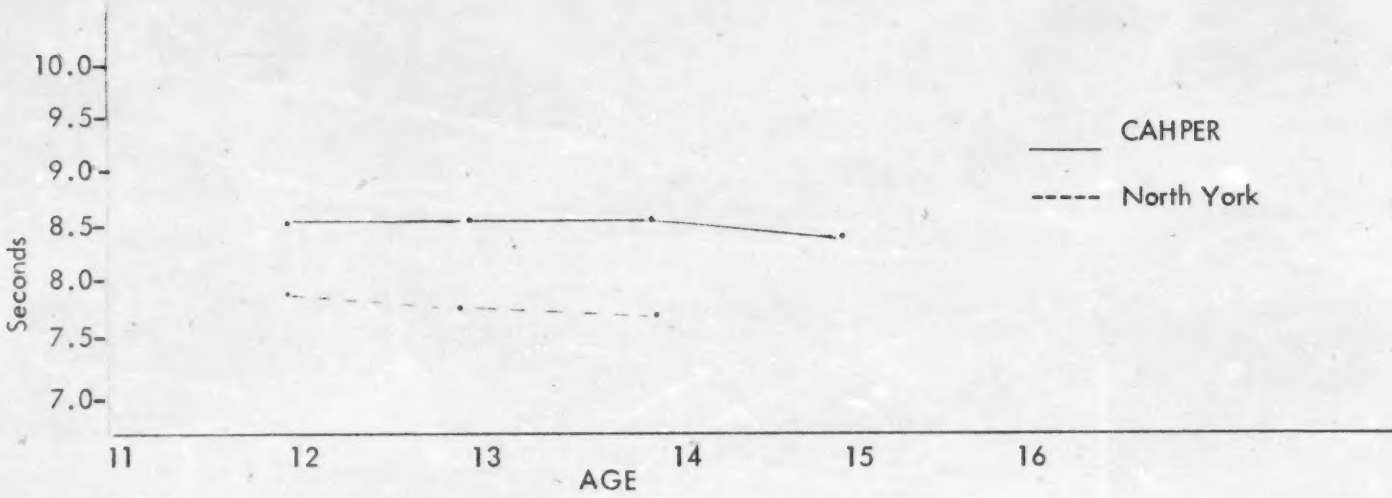
GRAPH 8

MEAN AGILITY RUN VALUES FOR MALES



GRAPH 9

MEAN 50 YARD RUN FOR FEMALES



GRAPH 10

MEAN 50 YARD RUN VALUES FOR MALES

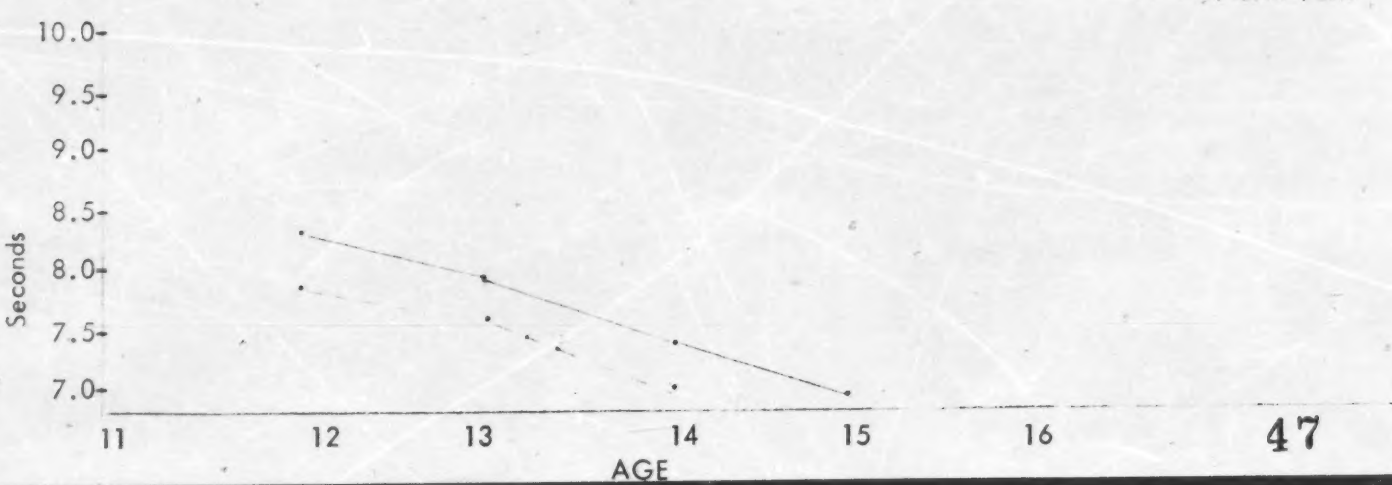


TABLE 21

MEAN 300 YARD RUN VALUES FOR GIRLS

IN EACH SCHOOL

EXPERIMENTAL			AGE		CONTROL	
300 Yard (Sec.) Mean	S.D.	N		N	300 Yard(Sec.) Mean	S.D.
68.0**	4.9	79	12	78	65.9**	5.8
67.0**	5.7	96	13	91	64.2**	6.5
66.0	6.7	63	14	69	65.2	7.0

** Differences significant $p < .01$

Table 21 indicates the similarity in mean 300 yard values for 14 year olds, between the girls in both schools, however there is a significant difference between the 12 and 13 year olds ($p < .01$). In both schools, there is a decrease with age, though this tendency is more vivid in girls of the experimental school.

TABLE 22

MEAN 300 YARD RUN VALUES FOR BOYS
IN EACH SCHOOL

EXPERIMENTAL				CONTROL		
300 Yard(Sec.) Mean	S.D.	N	AGE	N	300 Yard (Sec.) Mean	S.D.
66.3***	5.4	65	12	75	62.5***	5.7
63.1**	4.5	71	13	75	60.8**	4.5
58.9	4.7	58	14	73	57.4	5.4

** Differences significant $p < .01$
*** Differences significant, $p < .001$

Table 22 shows little difference between the mean values of boys at 14 years but a significant difference between 12 and 13 year olds in both schools. The values decrease with age in both cases.

TABLE 23

MEAN 300 YARD RUN FOR BOTH SCHOOLS COMBINED

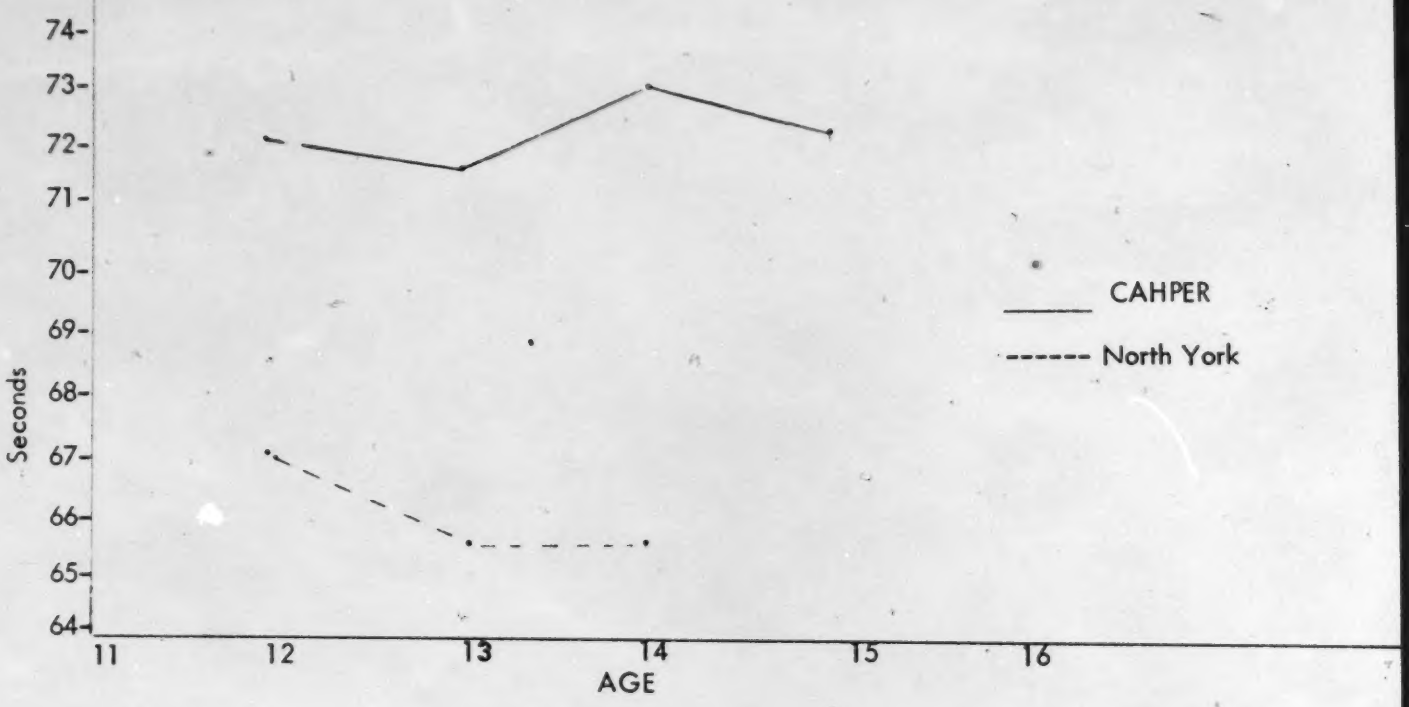
ALL BOYS 300 Yard (Sec.) Mean	S.D.	N	AGE	N	ALL GIRLS 300 Yard(Sec.) Mean	S.D.
64.3	5.9	148	12	157	67.0	5.5
62.0	4.7	157	13	194	65.7	6.3
58.1	5.2	137	14	136	65.6	6.9

Table 23 shows the mean 300 yard run values for all girls and all boys in both schools. The boys' mean values decrease with age to a greater degree than the girls' values.

Graphs 11 and 12 show the mean 300 yard run values for females and males for the North York sample, as compared to the Canadian norms. North York average scores are significantly lower than the Canadian norms for both sexes, ($p < .001$), particularly the girls. North York scores for girls also show a steady decrease whereas the Canadian 14 year olds have tended to increase their score.

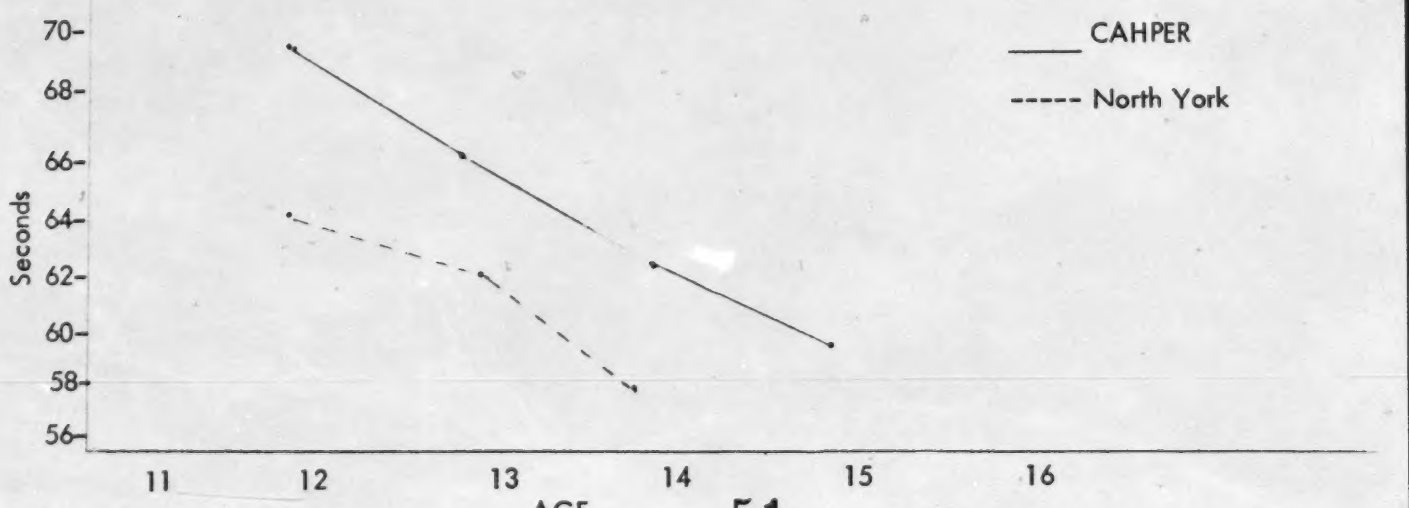
GRAPH 11

MEAN 300 YARD RUN VALUES FOR FEMALES



GRAPH 12

MEAN 300 YARD RUN VALUES FOR MALES



CONCLUSIONS

The aerobic fitness of boys in the experimental school, as measured by PWC_{170} and Astrand, improved significantly from pre- to post-test, while that of boys in the control school did not. This pattern of results was evident for girls on the Astrand measure, but was not as clearcut in terms of PWC_{170} on the 12 minute run, both boys and girls in the experimental school significantly improved their performance from pre- to post-test, while that of control students declined. On the 600 yard run, gains were in the direction hypothesized but were not significant.

The low correlation of the Astrand and PWC_{170} score, with the 12 minute run, suggested that on an individual basis some students were deriving little, if any, aerobic benefit from running. It is recommended that students be taught to take their pulse for 10 seconds at the end of the exercise period. This would allow each individual to determine if the exercise has been of aerobic value.

On the basis of the above data pattern, it was concluded that six minutes of continuous exercise and/or three minutes of continuous exercise followed by an interruption of three minutes followed by three minutes of continuous exercise, resulted in significant increases in aerobic power.

Contrary to the hypothesis, there were significant differences between students in the experimental and control programs in terms of the non-aerobic measures of strength, speed and percent body fat. These differences varied with age and did not show any consistent trends.

The pre-test scores for both schools on the CAHPER measures were significantly higher than those of the Canadian norms. These results are available under separate cover from the authors.

REFERENCES

Astrand, P .O., Experimental Studies of Physical Working Capacity in Relation to Sex and Age. (Thesis) Copenhagen: Munksgaard, 1952.

Cooper, K.H. Aerobics. Bantam Books. 1968.

Ekblom, B. Effect of Physical Training in Adolescent Boys. Journal of Applied Physiology, 1969, 29, 350 - 355.

Goode, R.C., Levison, H., Hughes, D., Johnson, F. and Langer, H. A Longitudinal Growth and Development Study of Bright School Age Children. CAHPER Journal, 1969, 36, p. 27.

Saskatchewan Growth and Development Study. University of Saskatchewan, 1968.

Shephard, R.J., Allen, C., Bar-Or O., Davies, C.T.M., Degre, S., Hedman, R., Ishi, K., Kaneko, M., LaCour, J.R., diPrampero, P.E., & Seliger, C. The Working Capacity of Toronto School Children. Canadian Medical Association Journal, 1969, Part 1, Vol. 100, p. 560 - 566, Part II, Vol. 100, p. 705 - 714.

"The CAHPER Fitness Performance Test Manual for Boys and Girls 7 to 17 years of age". Canadian Association for Health, Physical Education and Recreation, 1966.

APPENDIX A

PHYSICAL FITNESS TEST SCORES

Staff Advisor Group _____

NAME _____

SERIAL NO: _____ HEIGHT: _____

AGE: _____ WEIGHT: _____

SEX: _____ BIRTH DATE: _____

1) O_2 uptake ($VO_{2\ max}$) Temp. _____

Load 2 _____ % O_2 _____ Vol (litres) _____ A.T.P.S.

Load 3 _____ % O_2 _____ Vol (litres) _____ A.T.P.S.

2) P.W.C. 170 _____ kpm/kgm/min

3) Distance covered in 12 min. _____ miles

4) Time for 300 yards _____ sec.

5) Time for 600 yards _____ sec.

6) Peak flow _____ litres/min. A.T.P.S.

7) Percentage Body Fat

Tricep _____ Suprailiac _____

Chest (males) _____ Abdomen _____

Back Thigh (females) _____ Front thigh _____

Subscap. _____

8) Grip Strength _____ pounds

9) Flexed arm hang _____ sec.

10) Sit-ups in 60 sec. _____

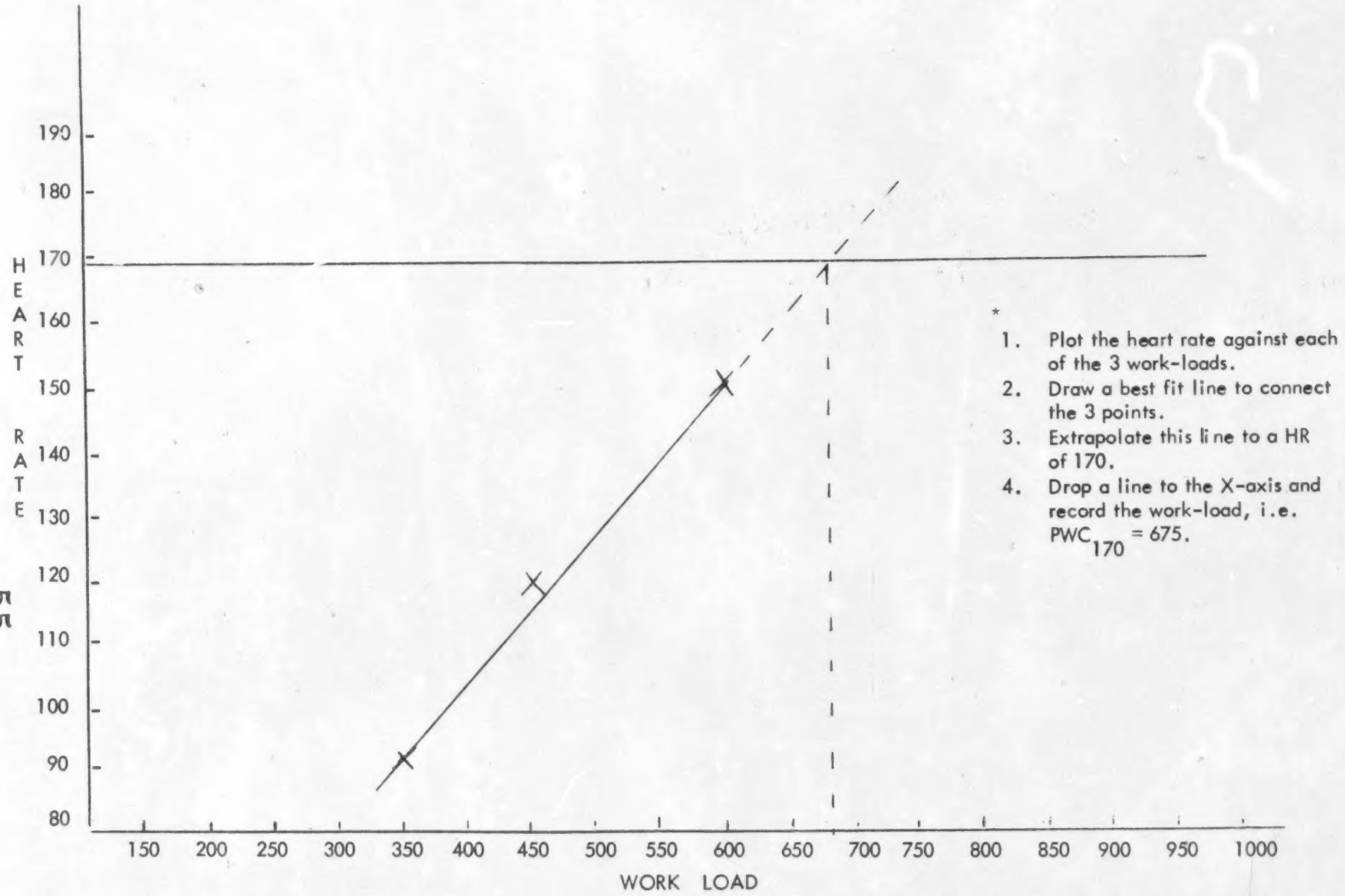
11) Standing Broad Jump _____ inches

12) Time for agility run _____ sec.

13) Time for 50 yard run _____ sec.

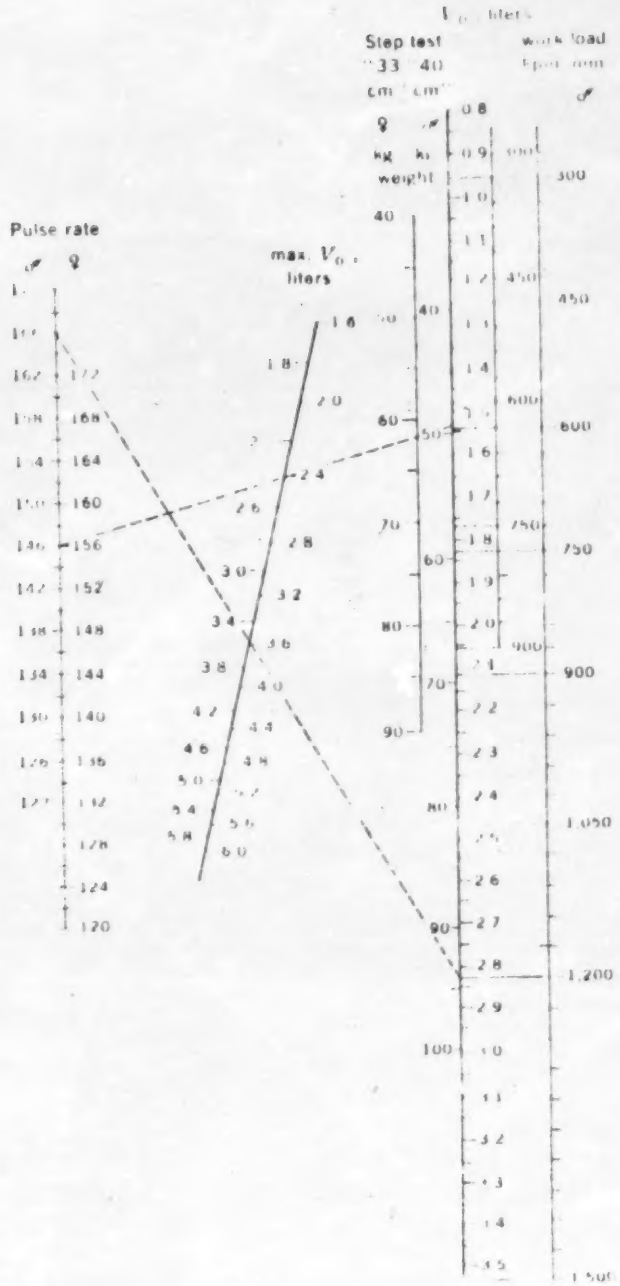
PHYSICAL WORK
CAPACITY 170

APPENDIX B



*

1. Plot the heart rate against each of the 3 work-loads.
2. Draw a best fit line to connect the 3 points.
3. Extrapolate this line to a HR of 170.
4. Drop a line to the X-axis and record the work-load, i.e. $PWC_{170} = 675$.


Step test
33 40
cm cm
work load
kg lb
weight
Pulse rate
max. V_{O_2}
liters
liters

APPENDIX C

1. From the results of the students' bike test, take the work-load that brought the students' heart rate closest to 150 beats per minute.

2. Read the work-load off the nomogram (600) and find the heart rate (146).

3. Join the 2 points.

4. The line you have just drawn intersects the maximal oxygen uptake line - Read the value (2.41/min.)

5. Divide this by the individual's body weight.

6. This gives you the individual's Astrand value.

WINDFIELDS JUNIOR HIGH SCHOOL

FALL PHYSICAL FITNESS TEST RESULTS

Student's Name: _____ Grade: _____

Staff Advisor: _____

1. CARDIORESPIRATORY FITNESS

A) Cardiorespiratory fitness (or endurance fitness) is the most important factor in human performance. It refers to the ability of being able to persist in prolonged general physical activity, to resist fatigue and to do large amounts of physical work.

Cardiorespiratory fitness depends on:

i) efficient lungs, a powerful heart, and a good vascular system,
ii) strength of general musculature,
iii) body energy stores and its heat regulation capacity, skill and coordination.

The 12 minute run was one of the tests used to measure oxygen uptake or the ability of each child to supply oxygen to the cells of the body.

Your child ran _____ mile(s) in 12 minutes indicating that he/she is

_____ in this area of fitness.

RATING SCALE FOR BOYS

Grade	Low	Average	Above Average
7	1.0 - 1.2	1.3 - 1.5	1.6 - 1.7
8	.4 - 1.3	1.4 - 1.6	1.7 - 1.9
9	.3 - 1.5	1.6 - 1.7	1.8 - 2.0

RATING SCALE FOR GIRLS

Grade	Low	Average	Above Average
7	.5 - 1.1	1.2 - 1.3	1.4 - 1.6
8	.7 - 1.1	1.2 - 1.4	1.5 - 1.6
9	.4 - 1.1	1.2 - 1.4	1.5 - 1.7

2. GRIP STRENGTH:

Strength is the ability of the body or its segments to apply force. It is a major component of power and speed, hence it is very important in athletics. Strength also allows for an ease in the performance of daily tasks with less fatigue.

Women are less strong than men, mostly because of the difference in muscle size. Strength can be rapidly increased through resistance training exercises.

The grip dynomometer was used as a measurement of each individual's strength. Your child scored a vlue of _____ pounds which places him in the _____ category.

RATING SCALE FOR BOYS

Grade	Low	Average	Above Average
7	32 - 47	48 - 60	61 - 111
8	38 - 51	52 - 72	73 - 122
9	41 - 63	64 - 92	93 - 124

RATING SCALE FOR GIRLS

Grade	Low	Average	Above Average
7	28 - 40	41 - 52	53 - 81
8	26 - 43	44 - 60	61 - 101
9	32 - 51	52 - 66	67 - 84

WINDFIELDS (PRE-TEST)

3. % BODY FAT

The percentage of body fat was measured by skin fold calipers at several different areas of the body. For the boys, the areas were the arm, back, chest, hip, abdomen and front thigh. For the girls, the areas were arm, back, hip, abdomen, front and back thigh.

The average range for body fat is 7.5 - 9.6 for boys, and 9.5 - 12.5 for girls in this school.

Your child obtained a value of _____ which is _____ in comparison to the other children in your school.

Adolescence is a period in one's development where the pattern for future life styles is set and therefore any tendency towards obesity should be checked. This fat content in the body can be controlled by proper diet, nutrition and physical exercise.

4. PEAK EXPIRATORY FLOW

Peak expiratory flow (P.E.F.) is the measure of the maximum flow rate of air (liters/min.) in a single forced expiration, as measured by Wright Peak Flow Meter.

The value of the measured P.E.F. is a relatively reliable and accurate indicator of an individual's lung ventilatory function. It reflects the strength or weakness of the respiratory muscles and/or airway obstruction.

The P.E.F. rate is less in women at all ages as compared to men, mainly because of the smaller body size and lesser muscular development. It is influenced by the level of physical fitness and body build.

A relatively high P.E.F. value indicates that you are capable of moving air in and out of the lungs quickly. This is important and advantageous to you, particularly when you are involved in sports or other physical activities.

Conversely, a low P.E.F. rate can interfere with your physical performance.

To maintain your P.E.F. level it is recommended that you participate, on a regular basis, in a suitable aerobic type of physical activity programme.

Your child scored a value of _____ which is _____ in comparison to the other children in the school.

WINDFIELDS JUNIOR HIGH SCHOOL

PHYSICAL FITNESS SPRING TEST RESULTS

Student's Name: _____ Grade: _____

1. CARDIORESPIRATORY FITNESS

Cardiorespiratory Fitness (or endurance fitness) is the most important factor in human performance. It refers to the ability of being able to persist in prolonged general physical activity, to resist fatigue and to do large amounts of physical work.

Cardiorespiratory fitness depends on:

i) efficient lungs, a powerful heart, and a good vascular system,
ii) strength of general musculature,
iii) body energy stores and its heat regulation capacity, skill and coordination.

The 12-minute run was one of the tests used to measure oxygen uptake or the ability of each child to supply oxygen to the cells of the body.

Your child ran _____ mile(s) in 12 minutes indicating that he/she is

_____ in this area of fitness.

2. GRIP STRENGTH

Strength is the ability of the body or its segments to apply force. It is a major component of power and speed, hence it is very important in athletics. Strength also allows for an ease in the performance of daily tasks with less fatigue.

Women are less strong than men, mostly because of the difference in muscle size. Strength can be rapidly increased through resistance training exercises.

The grip dynamometer was used as a measurement of each individual's strength. Your child scored a value of _____ pounds which places him in the _____ category.

3. % BODY FAT

The percentage of body fat was measured by skin fold calipers at several different areas of the body. For the boys, the areas were the arm, back, chest, hip, abdomen and front thigh. For the girls, the areas were arm, back, hip, abdomen, front and back thigh.

The average range for body fat is 8.5 - 11.6 for boys, and 10.5 - 13.5 for girls this school.

Your child obtained a value of _____ which is _____ in comparison to the other children in your school.

Adolescence is a period in one's development where the pattern for future life styles is set and therefore any tendency towards obesity should be checked. This fat content in the body can be controlled by proper diet, nutrition and physical exercise.

4. PEAK EXPIRATORY FLOW

Peak expiratory flow (P.E.F.) is the measure of the maximum flow rate of air (liters/min.) in a single forced expiration, as measured by Wright Peak Flow Meter.

The value of the measured P.E.F. is a relatively reliable and accurate indicator of an individual's lung ventilatory function. It reflects the strength or weakness of the respiratory muscles and/or airway obstruction.

The P.E.F. rate is less in women at all ages as compared to men, mainly because of the smaller body size and lesser muscular development. It is influenced by the level of physical fitness and body build.

A relatively high P.E.F. value indicates that you are capable of moving air in and out of the lungs quickly. This is important and advantageous to you, particularly when you are involved in sports or other physical activities.

Conversely, a low P.E.F. rate can interfere with your physical performance.

To maintain your P.E.F. level it is recommended that you participate, on a regular basis, in a suitable aerobic type of physical activity programme.

Your child scored a value of _____ which is _____ in comparison to the other children in the school.